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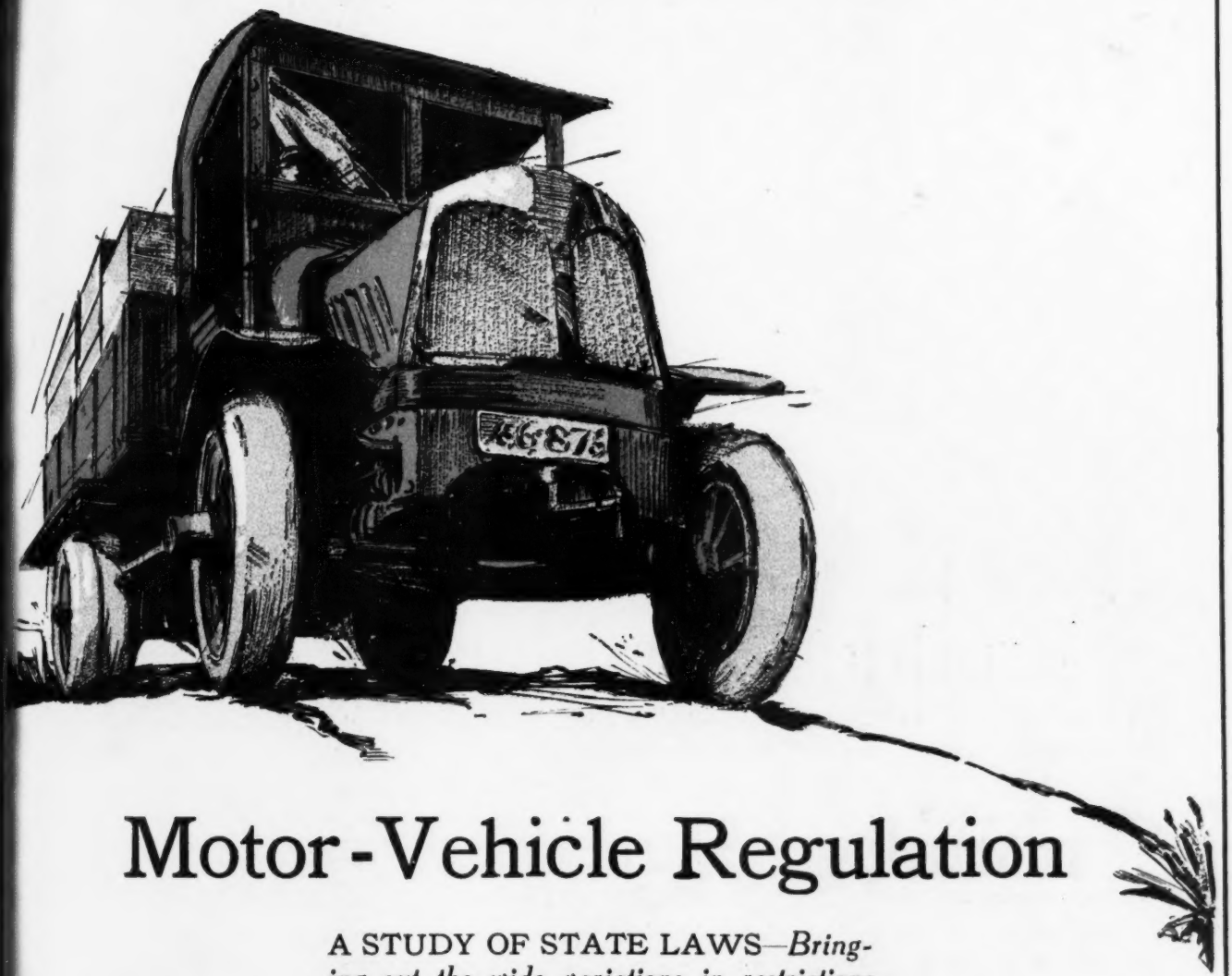

Motor-Vehicle Regulation

A STUDY OF STATE LAWS—*Bringing out the wide variations in restrictions and in methods of determining license fees.*

Complete digest of important features of each law, including license fees, weight and dimension limitations and speed regulations.

By R. K. Tomlin, Jr.

IN THIS ISSUE.—Monthly report on wages and labor conditions; full price list of materials; construction cost and construction volume index numbers.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 87 — NEW YORK, SEPTEMBER 1, 1921 — Number 9

Automobiles and Ice Cream

LAST week at Atlantic City Samuel Gompers stormed against those who begrudged the worker his automobiles and ice cream. We heartily agree with Sam; the idle rich should have no exclusive claim on gas buses and frozen sweets. Also we hold—and we hope that Sam agrees with us, though he forgets to make mention of the matter in his address—that the worker should *earn* his automobiles and ice cream. Some of them do—but in defiance of the union spirit, as any one will realize who reads the record of time-killing provisions in the national railway working agreements, and the restrictions imposed by labor union rules in the building trades. Automobiles and ice cream in abundance for all of us, workers by brain as well as by hand—but always with the proviso that we *earn* them. Incidentally we have no doubt that Sam and his confreres in the supreme councils of the American Federation of Labor are getting their ice cream—at about 50 cents a plate. Their meeting last week was in the Ambassador—renowned for stiff prices, even in Atlantic City.

Discounting Efficiency

SEEMINGLY an effort has been made to disparage Henry Ford's operation of the Detroit, Toledo & Ironton Railroad. Wide publicity has been given to statements that revenues were increased largely by hurling all available Ford plant traffic over this line, which crosses practically every trunk line from the Canadian border to the Ohio River. It is probably true enough that the spectacular increase in traffic has been due directly to this cause, and how much has been due to traffic influence through better service is as yet unknown. But the fact remains that Henry Ford is operating this line with about 40 per cent less force than under the old management and is hauling a tremendously greater tonnage than before. This has not been disputed and the remarkable increase in operating efficiency is obvious. The public will be more sympathetic toward willingness of the railroads to profit by the Ford object lesson than it will be toward efforts to discount efficiency that is established.

Fires and Shipping Piers

UNTIL the board of review prescribed by army regulations makes its report on the Hoboken pier fire of Aug. 24 all of the facts in the case will not be known, but enough is available to make it obvious that here was another of those too-frequent fires in shipping piers of inadequate fire resistance and protection. The piers where the fire centered were the 40-year old remainders of the Hamburg-American group and the only ones of the one-time German section which were not rebuilt following the terrible conflagration of 1900. They were of wooden construction, apparently not sprinklered and only inadequately guarded by water mains and hose. Even though the contents must have been of lower inflammability than usual on commercial piers, the structure itself stood little show once a fire started. Pier fires are notably hard to fight and extremely destructive when once fairly started. There is abundant reason why the design and protection of piers against fire should be given more consideration even than in the ordinary commercial building.

A New Meetings Plan

A DEPARTURE in the method of conducting its monthly meetings is disclosed in the August *Proceedings* of the American Society of Civil Engineers. During the last two years occasional subjects have been scheduled that were not covered by pre-printed papers. The general rule, however, has been to devote the meetings to submitted papers, if contributions lending themselves to discussion were available. Under the new arrangement all meetings up to and including that of January are preempted by assigned subjects. No opening is left for the scheduling of submitted papers, except, obviously, those pertaining to the five subjects scheduled. Each of the scheduled topics is to be dealt with, it is expected, in several sessions. The new plan has obvious advantages. It will develop important subjects broadly, and, since speakers from outside New York are to be invited, will endow the meetings with more of a national flavor. However, the plan will discourage the writing of papers, for many are attracted to write not merely by the hope of publication but of public presentation. In some way there must be provision for public presentation of such submitted (and accepted) papers as lend themselves to discussion in open meeting.

Federal Road Bill Delayed

IN THE FORM in which it passed the Senate last month the federal-aid highway bill is radically different from the measure originally drafted by Senator Townsend. Many concessions had been made to the proponents of the House bill, fathered by Representative Dowell, but, in spite of this no agreement on the revised bill was reached before Congress recessed. Most important among the changes in the amended Townsend measure was the recession from what appeared to be an unalterable stand in favor of a federal highway commission and the acceptance of the Secretary of Agriculture and, through him, of the Bureau of Public Roads as the federal administrative agency. Months ago the plan for a national highway system, to be built and maintained entirely with federal funds, was abandoned by Senator Townsend so that the main issues on which there had heretofore been controversy had disappeared. With these bones of contention removed it was thought that agreement would be easy, but that apparently has not been the case. There is a nigger in the woodpile somewhere—possibly in the fact that there is a strong pressure for economy in appropriations.

Reasons for a Margin of Safety

FUNDAMENTAL conceptions of structural safety are involved very intimately in the notorious case of the Boston molasses tank failure, an accident still on the calendar of unsettled cases, inasmuch as it is yet in the courts. From the start it presented the amazing spectacle of a piece of steel construction in full-load service, with direct stress—which means ideal minimum stress—exceeding 30,000 lb. per square inch, and so built as to give ample opportunity for additions to this stress by secondary effects. However, expert testimony was given to the effect that this stress was safe, a view contrary to precedent and seriously disturbing to all sound instincts of structural design. Fortunately the chances of harmful influence upon structural opinion and practice arising from the favorable testimony on the molasses tank are neutralized by the testimony given by expert witnesses for the other side in the pending litigation. Even in the brief form in which this testimony is reviewed in this issue, it has a wholesome, refreshing influence upon structural ideals.

Structural Safety Attainable

CRUMPLING up during quiet flight, with no apparent cause from stress of weather or service, a giant dirigible carried down some two-score persons to their death last week. With the shock of the tragic occurrence there comes also the recognition that the accident adds another black chapter to a grim record of disaster. Is the dirigible balloon a safe vehicle of transport? It has a bad history, and those who assert its safety bear a heavy burden of proof. This seems even more evident when the present scanty facts of the disaster are considered: serious trouble from structural weakness some time before the accident, hasty efforts to strengthen the frame, and finally the unprovoked failure of this presumably strengthened vessel—all suggesting that the builders had struggled aimlessly, and unsuccessfully, between the conflicting requirements of strength and lightness.

In order that sound opinions about this branch of aerial navigation may be maintained, one or two of the numerous points of obscurity concerning the Hull disaster should be cleared up as soon as may be practicable. The first is the fundamental question of competence in the construction: Was every opportunity taken to apply the knowledge gathered from past experience? In other words, was the collapse the result of faulty or neglectful design, or does the accident truly represent insufficiency of existing knowledge? Next, but related to the preceding, is the question of whether this dirigible was planned on a scale so far beyond the range of past experience as to make the failure attributable to that fact itself. The danger of an abrupt change of scale of construction is known from many past experiences, and if excessive size is the secret of the present accident, there is less occasion for alarm. But in that event it becomes more surprising that 45 or 50 valuable lives were put at risk in a machine whose safety was still questionable.

One fact of the disaster, in some respects its most damning feature, yet gives reason for a hopeful view as to the possibilities of the dirigible: the fact that the fall was due to a structural failure, not to defects of the lifting or driving equipment. If the constructors of aerial vessels have mastered all their problems other than structural, if they have made gas bags, machinery, and controls quite dependable, the outlook is bright, for nothing remains but to perfect the structural element of the vessel, and the road to this objective is a well explored one. The loading must be determined, and thereafter it is only necessary to apply the resources of a well developed art to obtain completely sound construction. The difficulties which lie in the determination of the loads, may need to be approached by gradual steps; for the phenomena involved in the resistance of a slender bag structure hundreds of feet long to air forces are as indeterminate as those of wave loading on a ship's hull, and at the same time vastly more complex than the latter. But certain it is that every experience in aerial navigation will contribute to building up an increasing body of knowledge, leading constantly closer to the required certainty and safety.

In the infinitely more difficult field of airplane construction, a truly wonderful degree of reliability has been attained—and this during a period much shorter than the history of lighter-than-air navigation. This result was achieved by ceaseless, undismayed work at the solution of the many baffling problems presented. Much of the knowledge had to be gained at the cost of accident, but each accident was used as a step to fuller knowledge and sounder construction. If the only remaining problems of dirigible construction are of the structural kind, a simpler and more rapid development may be forecast.

Honoring Honorary Members

SAMUEL REA and Ambrose Swasey have been elected honorary members of the American Society of Civil Engineers. The news comes to the profession, two months after the event, in the August *Proceedings*, through a note in the minutes and a five-line paragraph introducing cold, lifeless biographies of the two engineers. We have no doubt that the secretary in apprising them of the board's action did so graciously and humanly, but so far as the members are aware the event gets about as much attention as the routine approval of current expenditures. There is nothing human about it, no effort to raise it to its proper place as a significant event in society affairs.

The colleges do this sort of thing better. They confer degrees publicly, and accompany the ceremony with an appreciative formula setting forth the reasons for the honor.

The latter feature—an appreciative expression—is especially called for in electing to honorary membership. Mr. Rea was not honored for his record as a technical engineer, nor Mr. Swasey for his work as a scientist-manufacturer, but both of them for qualities and achievements that go beyond those generally associated with their special callings—Mr. Rea for his mastery of finance and organization, Mr. Swasey for his broad sympathies (which have always included the civil engineers in their wide embrace) and his encouragement of research. The directors in electing these honorary members did not indulge in a cold, intellectual process, but did it with enthusiasm and warm blood coursing through their veins, sensible of the honor they were conferring and of the luster which, in turn, would be shed on the society, but they have let none of that enthusiasm and warmth escape so that they would carry over to the members the importance of the action.

It is not too late to act—and abandon the old precedent of rigid formality and coldness.

Motor-Vehicle Legislation

IN THE study of motor-vehicle legislation, which is made a feature of this issue, the outstanding points lie in the wide variations disclosed (1) in the licensing fees of the various states, (2) the basis of determining the fees, and (3) in those elements which have a direct bearing on the cost of highway construction and maintenance, namely, weight and speed of motor trucks. From a study of these variations important dollars and cents lessons can be drawn.

In the matter of fees, for example, in the case of a 5-ton truck the maximum variation is 5,900 per cent, representing fees for the *same* vehicle of $5 per year in one state and $300 in another. This, of course, is an extreme case, but even for a commonly used type of vehicle, the 25-hp., five-passenger car, a range in fees of nearly 600 per cent is shown by the figures.

There is ground for debate as to whether a given class of vehicle should pay the same registration fee in every state. Even so, there can be no sound defense of the wide variations which actually exist. Moreover, the charging of fees that are generally conceded to be too low is occasioning a very heavy loss to the road maintenance funds of the country. In the drafting of the proposed uniform vehicle law the automotive interests were active and it can be fairly assumed that the scale of fees decided upon is none too high. Yet many states are failing to receive from the motor-vehicle users the revenues which their own spokesmen have accepted. American highway practice has often been indicted on the charge of neglect of maintenance after construction has been completed. The answer has often been made that no funds were available. In the case of a state with fees radically lower than those recommended in the uniform law, the problem of increasing their road maintenance funds has a ready solution. The fees in the uniform law should, at the very least, be accepted as minimums.

In the 48 states there are no less than seventeen bases for determining license fees. These range from the simple method of so many dollars per horsepower or per unit of gross weight to an involved computation in which four elements—list price, weight of vehicle, horsepower, and carrying capacity—figure. A standard basis was recommended almost two years ago by a joint committee of motor vehicle and highway interests and involved two factors, horsepower and gross weight, with a differential in favor of pneumatic as against solid rubber tires. While some of the states have accepted the basic principles contained in this proposed uniform law, a great many have acted independently, with the result that a hodge-podge of legislation has been produced.

As to the third element of variation—weight and speed limitations—it is apparent that today the motor truck is the determining factor in the design of interstate and other trunk-line highways, as contrasted with conditions a decade ago when the passenger automobile was the highway designer's main consideration. Gross weight and impact are the two new elements which figure most prominently, and the states are properly beginning to impose gross weight restrictions on motor trucks. Motor vehicle manufacturers and highway engineers, however, are not by any means in agreement as to what the gross weight limit should be. The proposed uniform law specifies 28,000 lb.—which would permit the operation of a 7-ton truck—but it is to be noted that the representatives of the highway officials on the joint committee did not concur in so high a limit. Naturally, the restriction of gross weight should depend to some extent on the character of the highway system; trucks which might operate without undue damage over the hard surface routes of states like New York and Pennsylvania would do irreparable harm in New Hampshire or on the sand-clay roads of certain Southern states. Many highway engineers, however, feel that a 5-ton truck is about all they should be called upon to provide for. The motor-vehicle operator contends, with reason, that shipping costs are reduced by the use of large highway transport units. This statement is true only in so far as it represents the actual cost of haulage. The true cost, of course, must depend not only upon the cost of operating the vehicle itself, but of building and maintaining the road-bed over which it travels. When these latter factors are taken into consideration the case for the excessively large truck unit is decidedly weakened. An ultimate economic loss results when huge trucks, even though they may show a reducton of a few cents per ton-mile, damage a road to an extent which makes necessary the floating of a bond issue of many thousand dollars for road reconstruction purposes. The State of Maryland has had an experience of this sort, the outcome of which has been the refusal to register a truck exceeding five tons' carrying capacity, or a gross weight of 20,000 lb.

Closely associated with gross-weight limitations is the matter of tire equipment and the recent Bureau of Public Roads' impact tests which throw interesting light on the subject. Comparatively few of the states, in their motor-vehicle laws, give pneumatic or cushion tires the concessions which these tests indicate are equitable. As for the solid tire, recent amendments to several state laws prescribe a minimum *thickness* of rubber, in recognition of the fact that serious damage can be done to a highway surface if the rubber on the wheels has been worn so thin as to make the tire practically non-resilient. This is a new feature of motor-vehicle legislation and one which has a direct bearing on lower road-maintenance costs.

By learning what other states are doing in an advanced way in these various directions, which is facilitated by Mr. Tomlin's analysis, it is hoped that there will come about some reasonable agreement regarding these limitations.

In all of these matters it is clear that no solution can be economically sound which is not based upon an equal consideration for the highway builder and the highway user. Many of our existing laws have been fathered by selfish interests, but the narrowness of viewpoint which characterized discussion of the subject half a dozen years ago is fast disappearing, for the leaders in the highway engineering and the motor-vehicle fields have come to a realization that their ultimate aims are identical—the movement of the maximum traffic at a minimum cost. If the latter figure is to serve any useful purpose it must be all-inclusive—not based merely on a few of the many elements of which it should properly be composed.

In all probability the next few years will witness many further radical changes in motor-vehicle legislation. The occasion offers to highway engineers and motor-vehicle manufacturers an opportunity, through mutual understanding and co-operation, for constructive work in the interest of improved highway transport.

Construction Joints in Concrete Girders of 62½-Ft. Span

Unique Design Safeguards Reinforced-Concrete Garage Under Williamsburg Bridge Against Cracking in Event of Uneven Pier Settlement

IN DESIGNING a one-story reinforced-concrete garage to be erected under the Williamsburg bridge, New York City, three-span continuous girders were contemplated. Upon excavating for the foundations soil conditions were found to be somewhat unsatisfactory for continuous action, the possibility being present of uneven settlement of piers. As the plans had already been approved by the Bureau of Buildings and the Department of Plant and Structures, New York City, to avoid loss of time in resubmitting new designs the engineer in charge resorted to the expedient of putting two construction joints in the center girders, leaving the reinforcing steel in all the girders as the approved plans called for, except for the shifting of the top bars toward the end girders.

These center girders have a span of 62 ft. 6 in. and the construction joints were placed in the center spans a distance of 14 ft. along the under face of the girder from the center line of columns. The idea of inserting the construction joints was to create two practical hinges, thereby rendering the girders statically determinate, the end spans having their inner ends cantilevered 14 ft. toward the center. The central portion —that part between construction joints—was simply supported at the cantilever end of the end span. The location of the joints was chosen so as not to change the size of the girders or the reinforcement of the original accepted design. The reinforcement of center girders remained as originally planned. At the construction joints three reinforcing bars were left in the bottom of the girders running through the joints. It was thought that in case of uneven settlement of the piers

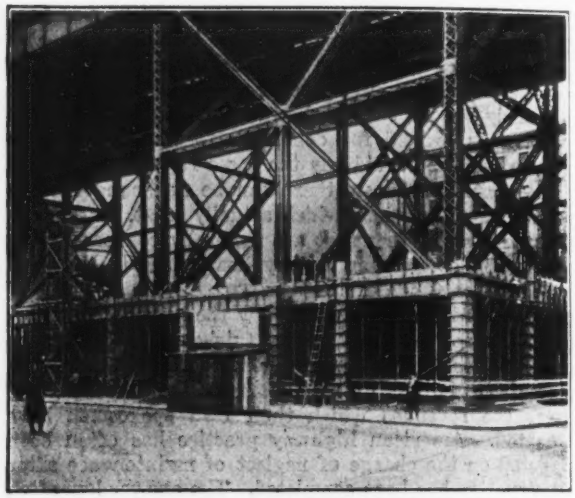


FIG. 1. WEST HALF OF GARAGE SHOWING BRIDGE STEEL

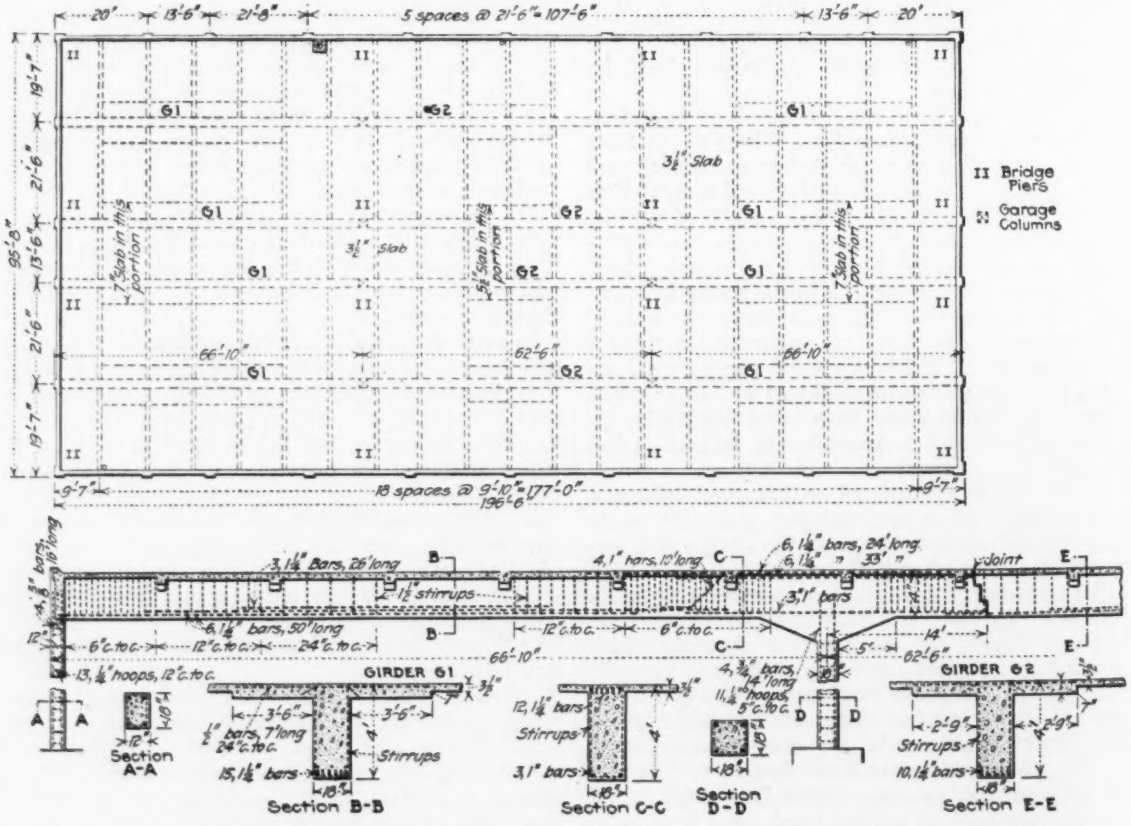


FIG. 2. PLAN AND ELEVATION, SHOWING COLUMNS IN RELATION TO BRIDGE PIERS AND REINFORCING

the joints would be flexible enough even with the three 1-in. bars running through them.

The garage is located under the Manhattan approach to the Williamsburg bridge on the south side of Delancy St., between Mangin and Goerck Sts., and only a few blocks from the East River. Excavation revealed a sandy and gravelly soil of quite widely varying bearing qualities at the different pier locations.

The garage is 196 ft. 6 in. long, 98 ft. 8 in. wide overall, and 16 ft. from the top of the floor slab to the top of the roof slab. The roof has a pitch of 2½ ft. in 47 ft. 10 in. The framing system is of columns 18 in. square surmounted by cantilever brackets, extending out from the column face 5 ft. and tapering from a depth of 24 in. at the column face to 0 at the 5-ft. distance; girders of a maximum span of 66 ft. 10 in., a depth of 4 ft. (including the 3½-in. roof slab) and 18 in. thick; and beams 12 in. deep (including the roof slab), and 8 in. thick.

There is little regularity as to spacing of columns, as the position of the bridge piers had some effect on the placing of garage columns. The plan is mind was to place columns as near to existing bridge piers as possible so that full advantage could be taken of storage area for cars. The garage columns are therefore in the same line, laterally, with the bridge piers. Longitudinally, there are but two interior columns. The center of the first is 66 ft. 10 in. from the outside face of the spandrel wall columns on the Goerck St. end. The span between the interior columns is 62 ft. 6 in., and the span to the other wall is 67 ft. 2 in. There are eight columns in a lateral direction, the spacing being 19 ft. 7 in. from the spandrel wall column to the first interior column, then 21 ft. 6 in., 13 ft. 6 in., 21 ft. 6 in., and 19 ft. 7 in., to the other wall.

The girders are 4 ft. deep, including the thickness of the slab, and 18 in. thick. This slab is increased to a depth of 7 in. where areas of greatest moment occur. The beams are spaced 9 ft. 10 in. c. to c. The slab is integral with the beam and the beam depth is 12 in., its thickness being 8 in. Reinforcement is as shown in Fig. 2.

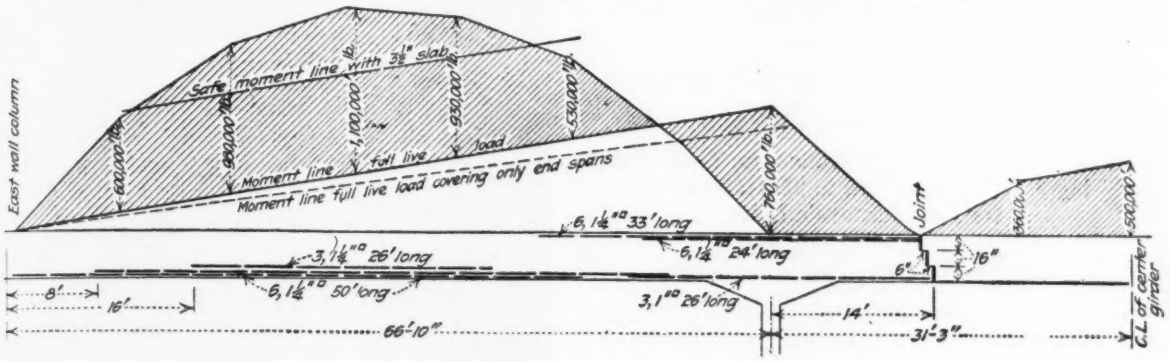


FIG. 3. MOMENT DIAGRAM FOR GIRDERS

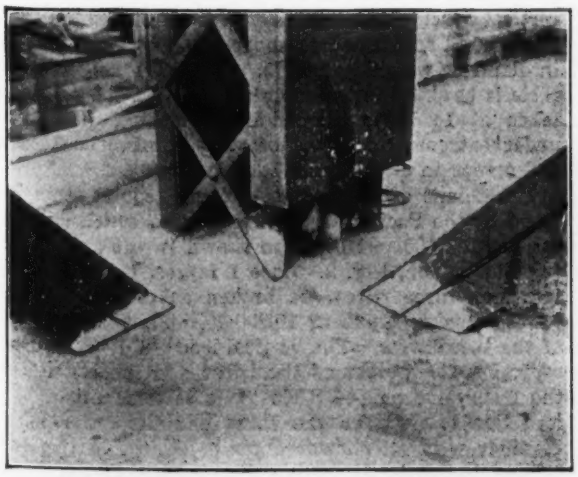


FIG. 4. ROOF SLAB LAID AGAINST STEEL COLUMN AND BRACING

The construction joints are stepped, the risers being 1 ft. 4 in. in height and the treads being 6 in. deep. The joints are soaped so that there is no rigid connection with the cantilever ends of the end beams, except through the three reinforcing bars at the bottom.

The footings for the four outside interior columns are 6 ft. square and generally 2 ft. 3 in. deep. Some foundation difficulties were encountered that necessitated deeper footings, the original design calling for both foundation walls and footings to go to undisturbed soil. Each pair of the four inside columns which are on 17½-ft. centers, are built integrally. These footings are 4 ft. wide and 7 ft. long, the slab joining them being 24 in. wide. The design of these footings called for a depth of 2 ft. 2 in. Two 1-in. bars 17 ft. long run through this section to give the twin footing its longitudinal reinforcement. Reinforcement in all footings is of ⅝-in. round corrugated bars placed on 3-in. centers.

The floor slab is of 1:3:6 concrete, 6 in. thick and laid upon an 8-in. cinder base. All concrete in the building is of 1:2:4 concrete. The walls of the garage are of brick filler laid in portland cement mortar and the lighting is secured through three bay steel sash glazed with double thick grade B glass, the steel sash being 14 ft. 11⅛ in. wide and 9 ft. high. The outside face of the piers, lintels and sills are to be rubbed smooth with carborundum stone and finished with white cement.

After the footings were put in no further concreting was done until the formwork for the entire building had been erected. When the pouring began some inconvenience was encountered in pouring around lateral braces of the steel bridge. The concrete was poured flush with the steel and connections between the two thoroughly waterproofed. It will undoubtedly be necessary further to waterproof the joints between the concrete

and steel as the concrete shrinks away from the steel. The roof slab is to be covered with a five-ply tar and gravel roofing.

The garage was designed by Missac Thompson, Brooklyn, N. Y. The Melton-MacDonald Co. were the contractors for the concrete work.

The ground is leased from the New York City Department of Plant and Structures for a term of ten years, with the privilege of renewal for a further period of ten years. At the expiration of the lease the building will be turned over to the city. The garage was built for the Concrete Building Co.

Tests on Full-Size High-Voltage Transmission Towers

Vertical, Longitudinal and Transverse Loads Totaling 38.8 Tons Applied to 98-Ft. Towers for New California Line

By Eugen F. Kriegsman
Engineer with F. G. Baum, Consulting Engineer, San Francisco, Cal.

DECISION to construct a 220,000-volt 201-mi. transmission line to bring power to San Francisco from the Pit River hydro-electric plants now under construction in northern California has led to the design and construction of transmission towers of large size to carry heavy loads. In working out a suitable design for this service many factors were involved. Good practice in transmission tower design calls for rather light members and the result is a total weight of the tower that is

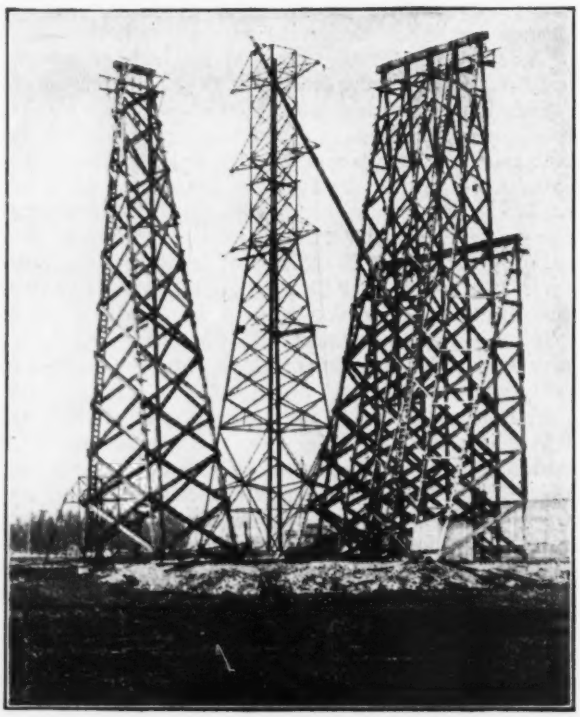


FIG. 1. TRANSMISSION TOWER UNDER 77,000-LB. PULL

only a small fraction of the load to be carried. For these reasons when new designs are proposed it is desirable to make a test of full-sized tower under full load. A test of that sort constitutes a check upon (1) the design, (2) the fit of the various members, (3) the clearance and spacing of bolts and members, and (4) the actual strength of the assembled tower. A series of such tests was recently made at the plant of the Pacific Coast Steel Co., in South San Francisco, where a testing stand had been built, arranged so that not only vertical loads but also large horizontal loads in two directions at right angles to each other could be applied near the tops of the towers. The method of testing, described in the following, was much the same for the various designs of towers tried out.

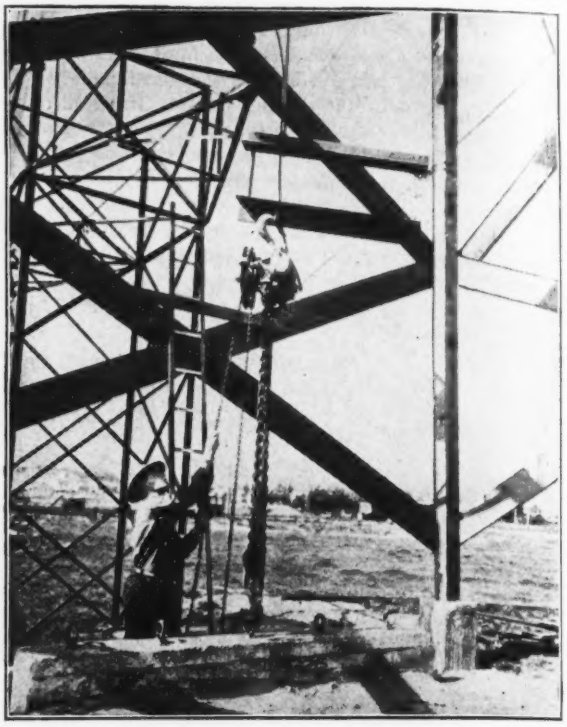


FIG. 2. CHAIN BLOCK, DYNAMOMETER AND REDUCING BEAMS

Standard towers and anchor towers for the open-country line, 98 ft. high, have a base 20 ft. square and three pairs of arms 24 ft. long tip to tip, with 15-ft. vertical spacing between them. Each of the six arms is designed and tested to support copper cable 0.91 in. in diameter weighing 1.54 lb. per lineal foot. Rope-lay cable is used. The load requirements for the test were taken at 1½ times the maximum loading anticipated under extreme conditions of wind, broken conductors and angles in alignment.

The details of the present loading requirements imposed by the Pacific Gas & Electric Co., which is building the 220,000-volt line, are shown in the accompanying illustration, Fig. 2. Case 1 represents a condition in which three wires are broken on one side of the tower, causing a pull of 10,200 lb. on the end of each of the three arms. The vertical loads of 1,400 lb. each represent the weight of the wires and insulators, and the transverse pull of 8,800 lb. is to take care of any load due to wind on the wires and the tower itself, together with an allowance for a 22-deg. in the line.

This test is to determine the strength of the tower in torsion.

Case 2 represents the situation with all six wires

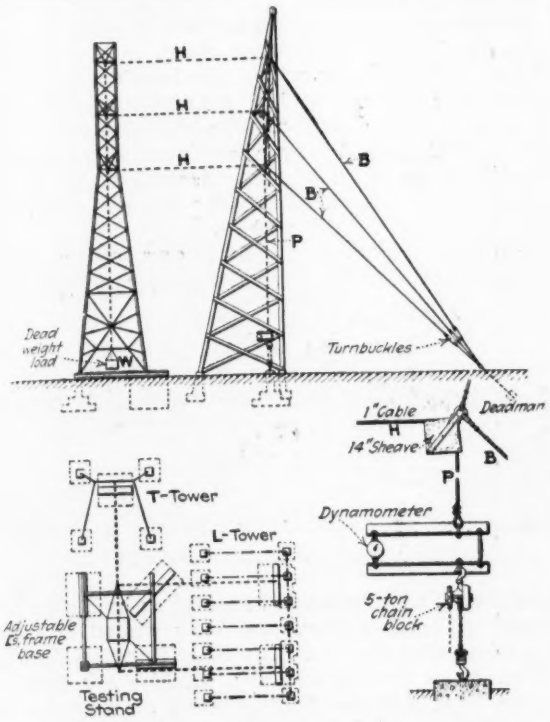


FIG. 3. PLAN AND ELEVATION OF TESTING STAND AND DETAILS OF PULLING DEVICE

broken on one side of the tower, leaving a horizontal load of 10,200 lb. applied at the end of each arm. The vertical load, as in Case 1, represents the weight of the wire; the transverse pull of 7,900 lb. is the wind load. Thus, this test, which is to determine the strength of the tower legs, gives a total breast pull of 61,200 lb., a total vertical load of 8,400 lb., and a transverse pull of 7,900 lb., or a total load of 38.8 tons not including the dead weight of the tower itself.

The wooden testing frame shown in the view Fig. 1, which is the larger of the two frames used, is 100 ft. high and 40 ft. wide at the base, carrying guys attached to a deadman buried 10 ft. deep. The four piers supporting the test tower are capped with channel beams so arranged that they may be adjusted to varying sizes of tower base up to 26 ft. These piers were designed to resist a maximum uplift of 150,000 lb. per tower leg. One-half inch steel cables were used to suspend the vertical loads, consisting of bundles of angle irons previously weighed, from the ends of the cross-arms. The horizontal loads, i.e., the longitudinal and transverse pulls, were applied by a chain block and dynamometer arranged as shown in the illustration.

As it was found that trouble developed in details of the cross-arm more frequently than elsewhere, the arms were tested on the ground before being mounted on the tower. This was found to be a very satisfactory means of rectifying minor defects before the actual trial in the tower itself. Many fine points in detailing were finally adjusted in these supplementary ground tests.

Deflections of the tower under load were read by attaching fine copper wires to the tower cage the height of the center cross-arms and carrying them over 6-in. wheels in both testing frames *T* and *L*, Fig. 3, in the same manner as the pulling cables *H* and *P* were arranged. A heavy weight was suspended from the end of each copper wire and a carpenter's rule was attached to the wood frame just behind it. By noting the rise and fall of the weight against the carpenter's rule, the relative movements of the tower at the center arm in the directions *L* and *T* were recorded for the various loadings. Loads were usually applied in increments of 1,000 lb. and corresponding deflections noted. A typical tower, for example, gave a maximum deflection of $6\frac{7}{16}$ in. in the direction *L* and $1\frac{7}{16}$ in. in the direction *T* under the maximum loading of Case 2.

As the dynamometers were limited to a capacity of 5,000 lb., they were arranged with reducing beams arranged to give a reduction of 4 to 1. The dynamometers were calibrated by putting them in a string in a testing machine and comparing all readings. Tests were made on the friction loss on the 1-in. cables passing around the 14-in. sheave and an allowance of 2 per cent was made for the friction loss at this point when making the test pull on the towers.

The towers designed for this new 220,000-volt line have a double system of web members and consequently redundant forces occur in some of them. Secondary stresses due to elasticity of material and deflection of the tower often amount to a large fraction of the computed stress. The tests give assurance that these have been properly provided for. A series of tests run to determine the usefulness of some redundant members resulted in dispensing with certain members in the final tower.

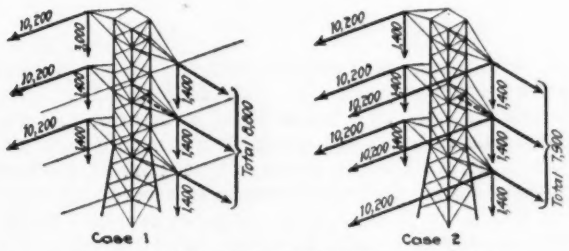


FIG. 4. TWO CASES OF TOWER LOADING

The steel used in the manufacture of these towers is a special alloy steel, having an elastic limit of 45,000 lb. per sq.in., an elongation of 22 per cent and a cold bend of 180 deg. flat on specimens up to $\frac{3}{4}$ in. thick.

The successful designer of such towers must continually keep in mind their ultimate purpose. Testing full-sized towers, supplemented with tests of details as herein described, is an important part of the engineering of supervoltage heavy-duty transmission lines, which ultimately will make cheaper power possible for consumers and for the rapidly growing industries of the west.

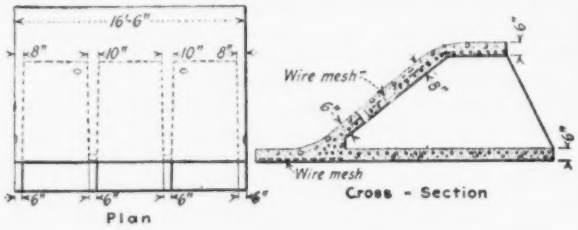
1,000-Ft. Steel Masts for Radio Station

A radio transmitting station which is to be completed at Shanghai, China, within the next 18 to 24 months, is to have its antenna supported by six guyed steel masts, each having a height of 1,000 ft. The steel in these masts will total about 200 tons in weight as compared to the 570 tons required for the 820-ft. self-supporting towers of the radio station at Bordeaux—the highest self-supporting radio tower thus far built. The Shanghai station is to be built by the Federal Telegraph Co. for the Chinese Government.

Precast Concrete Breakwaters Used in Lake Erie

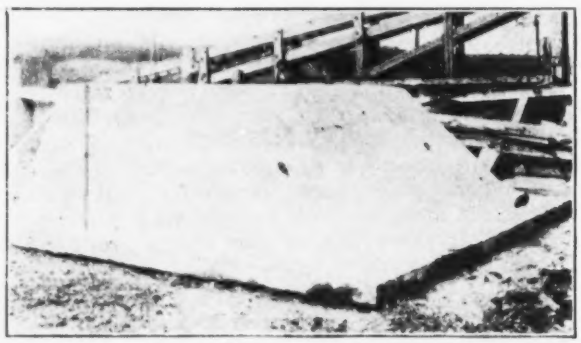
SHORE protection has been installed at a number of points along the south shore of Lake Erie by setting in place precast concrete breakwater sections made by the American Construction Co. at its yard in Cleveland. A breakwater of this kind is shown in the accompanying view. The construction and appearance of a single section are shown separately. As shown, the sections have been built commonly about 4 to 5 ft. high, but the builders say that they can be produced in heights up to 14 ft. A derrick boat can place as much as 125 lin.-ft. of this breakwater in a day.

The design was prepared as the result of long experience with pile jetties, timber crib and stone break-



PLAN AND SECTION THROUGH PRECAST CONCRETE BREAKWATER

water construction along the lake, all of which have proved weak or ineffective. According to L. A. Wells, of the company that builds these structures, the pile jetty fails to break the waves and therefore does not retain the sand, while timber crib construction offers a perpendicular face which results in severe undermining action, so that after a few years the crib either washes away or it sinks below the water level and fails of its purpose. Decay and disintegration of stone-filled cribs are also causes of complaint. Stone breakwaters, built by depositing large quarry stone on brush mattresses, have been found subject to shifting when used as shore protection, and are not tight enough to retain the sand against the washing and sucking action of the waves. In the concrete breakwater a sloping face

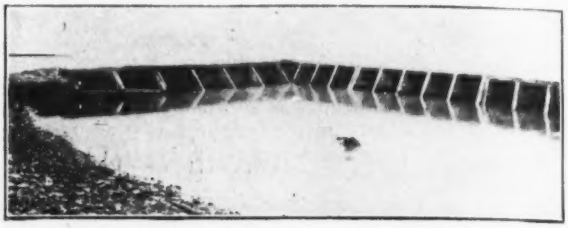


ONE OF THE PRECAST SECTIONS

and a large foundation area are provided, and the advantages of tightness and permanency are secured at the same time. The underlying idea is to offer no resistance to the seas, but to pocket the sand and thereby form a natural protection. In actual experience with the sections placed on brush mattresses the breakwaters are claimed not only to hold sand back of them but build a beach in front.

In construction the width of base is made to vary with the height, maintaining about the proportions shown in the sketch drawing. The length of section is dependent chiefly on the derrick capacity available and on convenience in placing. The cells, between cross-walls spaced about 4 ft., are tapered or wedge shaped, not only so as to permit ready removal of the forms but also to give no opportunity for damage from freezing of water within the pockets.

The shore arm or groin in this construction differs from the sea face or breakwater proper by having a



VIEW OF A TYPICAL BREAKWATER IN PLACE

central wall, with cross-walls exposed on each side. It is said that such a shore arm has a protective effect extending some distance. The effect being credited to the action of the cross-walls in breaking the advance of the waves and thereby facilitating the retention of sand. Patent of this breakwater construction has been applied for by Mr. Wells.

Oyster Shells as Road Surfacing

By Leo G. Hall
Onekama, Mich.

IT IS WELL known that in some of the Southern seaboard districts oyster shells are used for road surfacing with success. An example of such use was brought to the writer's attention in the construction of a cantonment in Virginia, where he had, among other things, the supervision of road construction The cantonment was on an estuary where there was considerable oyster fishing done, and that part of the ground immediately adjacent to the water was pretty well covered with oyster shells.

We built roads in their permanent locations for use in construction some months before the permanent paving was laid, by plowing a few furrows on either side, scraping from both sides to the crown, dragging and rolling. It happened that a road which passed through this shell-covered field was the last to be made, and the road roller suffered a bad breakdown just before it was rolled. In the hurly-burly of rush construction we never got back to finish it.

We were very much surprised, however, to find that a few rains, with routine dragging after each rain, compacted it to the point where it was by far the best road in the system. It did not become muddy during rains, nor dusty in dry weather. Heavy army trucks continually passing over it made no ruts. It always presented a hard, dense surface which shed water to the gutters on either side. The regular dragging to which all the roads were subjected was really superfluous on this one. The soil was a very light loam, which became very soft and muddy when wet, caked hard after rains and pulverized under traffic into a very light dust. All of the roads in the system except this one required constant attention to keep them even passable.

Telling the Importance of Engineering in Every-Day Life

EFFECTIVE PUBLICITY informing the public of the importance of engineering in the every-day life of the community was accomplished by window displays, motion pictures of engineering projects, engineering meetings, and newspaper publicity by the Missoula (Mont.) Chapter of the American Association of Engineers during "Engineers' Week," held in that city last spring. Fifteen window displays were on exhibition during the week, several of which created unusual interest in the community. Two of them are shown herewith. One depicted the importance of railroad grade crossing elimination, and another a combined exhibit illustrating various activities of the engineer and the mineral resources and industries of the state. Motion pictures of the Keokuk dam across the Mississippi, the Washington Power Co.'s hydro-electric development near Spokane, and modern concrete highway construction were shown during the week at the theaters. On each day of the week the newspapers devoted space to engineering articles of general interest, aiming to show the scope of the engineer's activities.

ENGINEERING PUBLICITY BY WINDOW DISPLAY

ENGINEERS' WINDOW EXHIBIT PORTRAYS GRADE CROSSING EVIL

TNT for Road Construction

TNT, in the opinion of Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, is an ideal explosive for use in road construction. Through his bureau 26,000,000 lb. have been distributed for road-building purposes, without a single accident. The fact that TNT does not freeze makes it popular.

Analytical Data Essential to Run Mechanical Filters

WHAT the sanitarian needs in the way of water analysis data in judging of the character of a water and what the filter operator needs to produce the water are not necessarily the same. Many tests the former would like the latter to obtain for him are useless data for every day operation. C. Arthur Brown in a paper presented to the Southwestern Water-Works Association says the following determinations are more or less valueless:

Dissolved Oxygen	Oxygen consumed
Albuminoid ammonia	Chlorine
Nitrates	Nitrites
Alum	Iron
Microscopical for algæ and diatoms	Bacterial isolation

Among the more or less valuable tests he names:

Turbidity	Color
Total alkalinity	Hardness
Caustic alkalinity	Carbonate hardness
Monocarbonate alkalinity	Sulphate hardness
Bicarbonate alkalinity	Chloride hardness
Free carbonic acid	Complete mineral analysis
Presumptive B. coli	Gelatin count at 20 deg. C.
Agar count at 37½ deg. C.	

By careful selection of the determinations actually required, according to Mr. Brown, the operator can usually reduce the number to a point where the routine work becomes relatively simple and capable of being carried on without undue burden. It is of no real benefit to clutter up the records with meaningless and useless data requiring valuable time to obtain and more valuable time to set down and transcribe.

Except where the plant is handling a grossly polluted water, such as Bubbly Creek, Chicago, there is no need of determining the ammonias, nitrites, nitrates and chlorines. In most plants there can be no need for making determinations of iron or alumina. There are only a few plants handling water where the tests for micro-organisms are of any value. To effect complete isolation of B. coli is usually merely an excuse for wasting one's time. It is equally ridiculous to report turbidities where the variation in turbidity is negligible. To report color on a water which does not carry more than 10 p.p.m. is a waste of time. Where the alkalinity is of one kind and does not vary enough to affect the results in any way, a general statement to that effect is all that is needed. In plants which do not soften, even where free carbonic acid is found, a long string of data has no meaning, unless perchance the system is in trouble from red water. The hardness cannot be reduced by merely reporting it and unless softening is carried on, it has no place in a report. The agar count at 37½ deg. C. may be of material benefit to the sanitary expert but its value to the operator is small, particularly if he has a count of 20 deg. C. on gelatin.

Counting out the necessary routine chemical tests needed at any one point, there is no determination which requires as much time and skill and which makes as small return to the operator as the 37½ deg. count, nor which, in the absence of the 20 deg. count on gelatin, makes as great and varied difficulties.

The Trend of Motor-Vehicle Legislation

Digest of Laws of the 48 States Relating to License Fees and Regulation of Weights, Dimensions and Speeds of Passenger Automobiles and Motor Trucks

By R. K. Tomlin, Jr.
Associate Editor, *Engineering News-Record*

IN THE country-wide revision of motor vehicle legislation which has been in progress this year, a well-defined trend toward higher license fees and more rigid weight restrictions is indicated. An analysis of the amended statutes, however, discloses wide differences among the states, both in the amounts of the annual fees for passenger automobiles and motor trucks and in limitations imposed on weight, size and speed. These features of motor-vehicle laws, of course, are the ones in which highway engineers are most directly concerned, inasmuch as the funds for road maintenance in most of the states are supplied, in whole or in part, by motor vehicle fees, while limitations on gross weight, weight per inch width of tire, speed, and tire equipment are determining factors not only in the life of existing highway surfaces but in the design for new construction. No argument is needed now, however, to support the contention that the regulation of vehicular traffic has taken a place of primary importance in the highway engineering field, for the subject has dominated the meetings of road builders for a year or more past. Nevertheless, the various states, in spite of the promulgation on Jan. 20, 1920, of a proposed uniform motor-vehicle law prepared by a committee representing both motor vehicle and highway interests, have gone their separate ways in making and amending their statutes and the results, in so far as they are of interest to highway engineers, are presented in the accompanying digest which *Engineering News-Record* has prepared from the various state laws and amendments thereto. An effort has been made to have the data correct as of July 1, 1921, but the states are constantly changing their motor-vehicle laws and some of the figures may need revision by the time this article is published.

Non-Uniformity in Fee Basis

Probably the first thing that a study of state motor-vehicle legislation emphasizes is the lack of uniformity in the *basis* of establishing license fees for both passenger cars and motor trucks. In the 48 states there are no less than 17 different bases or combinations by which the fees are fixed. For passenger cars the horsepower basis (used by 27 states) is the most prevalent, while for motor trucks the commonest form is the rated carrying capacity of the truck (used in 25 states). Other bases are: Gross weight (vehicle and load), weight of vehicle, cost, piston displacement, total tire width, flat rate per vehicle, and various combinations of the foregoing. In fact, the fee basis in one of the states, North Dakota, depends upon no less than four elements—cost of vehicle, weight of unloaded vehicle, horsepower and carrying capacity. In the joint committee's proposed uniform vehicle law, previously referred to, license fees for both passenger automobiles and motor trucks are determined on a basis of horsepower and gross weight, with a scale favoring pneumatic as against solid rubber tires.

With so many different bases of computing the license fee, it is readily understandable that few states make the same charge for the same machine. Thus, in the case of a medium-priced passenger automobile of about 25 hp., costing, say, $1,700, the fees range from a minimum of $5 to a maximum of $34, while in the case of motor trucks far greater variations occur, the range being from $5 to $300 per year for a 5-ton truck. On the other hand, a flat-rate fee per vehicle, irrespective of weight or horsepower, is operative in 3 states for passenger automobiles and in 2 states for motor trucks—obviously an illogical method of taxation in that the big, heavy vehicle is charged exactly the same fee as the light delivery truck, although its destructive effect on the roads may be many times greater.

TABLE I. DIFFERENCES AMONG STATES IN BASIS OF DETERMINING MOTOR VEHICLE FEES

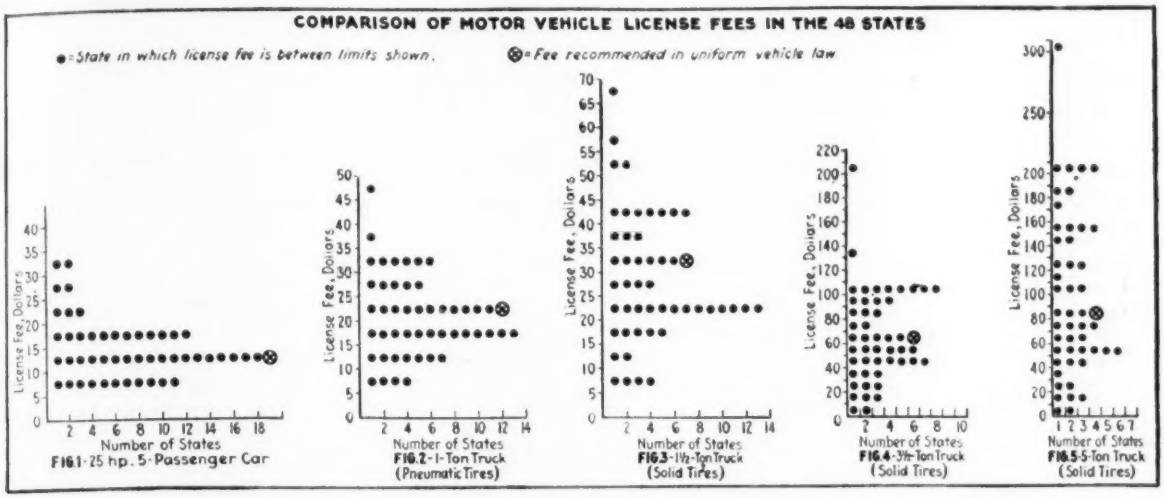
Basis of Determining License Fee	Number of States Using this Method for: Passenger Cars	Motor Trucks
1. Horsepower	27	2
2. Carrying capacity	0	25
3. Weight (vehicle only)	5	2
4. Gross weight (vehicle and load)	3	7
5. Cost of vehicle	2	1
6. Piston displacement	1	0
7. Total tire width	0	1
8. Weight of chassis	0	1
9. Flat rate per vehicle	3	2
10. Horsepower plus gross weight*	3	2
11. Horsepower plus weight unloaded	1	2
12. Horsepower plus cost	1	0
13. Horsepower plus capacity	0	1
14. Weight plus cost	1	0
15. Weight plus capacity	0	1
16. Weight plus horsepower plus cost	1	0
17. Weight plus horsepower plus cost plus capacity	0	1
	48	48

* Basis recommended in Uniform Vehicle Law.

Without going into the matter of the same license fee for the same vehicle in all states—involving as it does a host of local considerations—there can be no question as to the desirability of a standard *basis* of determining such fees. Whether it be in California or in Connecticut, the wear and tear on a road by vehicular traffic is governed by the same general principles, and should be paid for on the same general basis. Many of our state legislators, however, have spurned so direct a path to their destination of fee fixing as horsepower and gross weight, and have wandered off along tortuous mathematical routes ending in a veritable maze of figures, for which there is no justification.

Tire Equipment

If the amount of the license fee is to have definite relationship to the damage done to the road, it would seem that the type of tire should receive more consideration than has been accorded it by most of the state laws. In only 8 states is any reduction in the fee allowed for the use of pneumatic, instead of solid rubber, tires on motor trucks. Impact is now recognized as one of the most destructive agents in the upkeep of surfaced roads and the results of the research work upon which the U. S. Bureau of Public Roads has been engaged for some time past indicate a very marked reduction of impact in the case of pneumatic as against solid tires.


COMPARISON OF MOTOR VEHICLE LICENSE FEES IN THE 48 STATES
●=State in which license fee is between limits shown.
⊗=Fee recommended in uniform vehicle law
License Fee, Dollars
Number of States
FIG.1-25 hp. 5-Passenger Car
FIG.2-1-Ton Truck (Pneumatic Tires)
FIG.3-1½-Ton Truck (Solid Tires)
FIG.4-3½-Ton Truck (Solid Tires)
FIG.5-5-Ton Truck (Solid Tires)

In the report of these tests (see *Engineering News-Record*, March 31, 1921, p. 553) impact values with solid rubber tires are shown to be as high as 7 times the load on one rear wheel encountering a 1-in. obstruction at a speed of 16 miles per hour. The average impact, however, was about 4 times the wheel load when solid tires were employed. With pneumatic tires, on the other hand, the average impact was not more than 1¼, and the maximum not more than 1¾, times the static load. Impact, of course, is only one of the elements that enter into the destruction of a road by traffic, but it would seem desirable, in the interests of lower road maintenance costs, for the states further to encourage the use of pneumatic tires on trucks by allowing a lower license fee for vehicles so equipped than is called for in the case of solid rubber tires.

To a less degree these remarks apply also to the so-called "cushion" tires which, according to the U. S. Bureau of Public Roads tests, offer an advantage over solid tires in reducing impact, although it is pointed out by the bureau that the name "cushion" on a tire does not necessarily make it such a tire. In none of the state motor-vehicle laws, however, is consideration given to the cushion type of tire for motor trucks as a reason for lower license fees. In like manner the cushion wheel is neglected.

Tire equipment of motor trucks, however, is recognized in some of the state laws as playing an important part in the effect of the vehicle on the roads. New Jersey, for example, in the revision of its motor-vehicle law, this year, specifies in a detailed table the allowable wheel loads for tires of various widths and wheels of various diameters. The old, worn solid tire is not looked upon with favor in certain states, and minimum tire *thickness* is now being specified in a few cases. Connecticut, in its revised motor vehicle laws, enacted this year, requires a minimum thickness of ⅞ in. for solid rubber tires 5 in. wide, a minimum thickness of 1 in. for widths from 6 to 8 in., and a minimum thickness of 1⅛ in. for tires 8 in. or more in width. In California, also, a 1-in. thickness for solid rubber tires is specified as the minimum. Ohio has recently amended its motor-vehicle law by specifying a minimum thickness of ⅞ in. for a solid rubber tire 5 in. wide, 1 in. for a tire width of from 5 to 8 in., and 1⅛ in. for widths exceeding 8 in. In Oregon the weight on the axle of a truck is limited to 6,500 lb. in the case of a tire ¾ in. thick, and for axle loads exceeding 6,500 lb. the tire thickness must be at least 1 in. Generally, however, tire thickness is a neglected feature of motor-vehicle legislation, although the Bureau of Public Roads' impact tests sound a warning to the highway maintenance engineers against such worn-out wheel equipment. Speed, of course, must be considered in connection with thickness of rubber in the indictment of the worn, solid tire as a road-surface destroyer.

TABLE II. DATA ON "AVERAGE" TRUCKS OF FOUR CAPACITIES USED IN DETERMINING AMOUNTS OF LICENSE FEES

Cap., Tons	No. of Trucks Included in Average	Hp.	Wt. of Chassis, Lb.	Wt. of Body, Lb.	Total Weight, Unloaded, Lb.	Total Gross Weight, Lb.	Cost
1	6	22	3,000	1,000	4,000	6,000	$2,400
1½	5	23	3,500	1,200	4,700	7,700	2,700
3½	6	31	7,300	1,500	8,800	15,800	4,800
5	8	34	8,700	2,000	10,700	20,700	5,800

TABLE III. "AVERAGE" MEDIUM-PRICED AUTOMOBILE BASED ON DATA FROM NINE STANDARD CARS

H. P.	Wt., Lb.	Wt. 5 Passenger	Gross Wt., Lb.	Cost
25	2,700	750	3,450	$1,680

For purposes of comparison, based on the data in Tables II and III, there are listed in Table IV license fees in the various states as computed for five types of vehicles: A 25-hp. passenger car; a 1-ton truck equipped with pneumatic tires; a 1½-ton truck (solid tires); a 3½-ton truck (solid tires); and a 5-ton truck (solid tires). Before the license fees for all 48 states could be computed, however, it was necessary to determine for each type of vehicle, its horsepower, cost, tire equipment, weight (unloaded) and gross weight, inasmuch as each of these factors, or a combination of them, enter into the determination of the license fee in some of the states. An "average" vehicle in each class was found by selecting from the "Handbook of Automobiles" (1921 edition) of the National Automobile Chamber of Commerce a number of standard passenger automobiles and motor trucks and averaging in each case the horsepower, cost, weight of vehicle, etc. Following this method the medium-priced 5-passenger car was found to be one of 25 hp., weighing 2,700 lb. (or 3,450 lb. loaded with 5 passengers) and costing $1,680. The 1-ton truck was found to be of 22 hp., to cost $2,400, and to weigh, unloaded, 4,000 lb. The 1½-ton truck

Comparison of State Motor Vehicle Laws with Reference to License Fees, Weight, Size and Speed Restrictions

Abbreviations: Cap. capacity; Hp. horsepower; Wt. weight; < less than; > greater than.

State—and Vehicle Authority	Date of Act and Amendments	License Fees			Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
		Passenger Cars	Motor Trucks	Trailers			
ALABAMA (State Tax Commissioner)	Effective Oct. 1, 1919	*Hp.* — *Fee* Under 25 — $11.25 25–29 — 18.75 30–39 — 26.25 40 or over — 30.00 Electric — 20.00 Steam — 25.00	*Cap., Tons* — *Fee* Under 1 — $15.00 1–under 2 — 22.50 2–under 3 — 37.50 3–under 4 — 56.25 4 and over — 75.00	.....	Max. gross wt., 10 tons	.....	Max. 30
ARIZONA (Sec'y of State)	Effective June 9, 1921	*Hp.* — *Fee* 25 and less — $5.00 25–40 — 10.00 Over 40 — 15.00	*Cap., Tons* — *Fee* 1½ or less — $10.00 >1½–3 — 15.00 Over 3 — 25.00	.....	.....	.....	City — 10–15 Country — 30
ARKANSAS (Commissioner of State Lands, Highways and Improvements)	Passed March 20, 1921	Per hp. — $0.25 Per 100 lb. gross wt. — .25 (Min. fee, $10)	*Cap. Tons* — *Fee* Pneu. — *Fee* Solid 1 or less — $15.00 — $15.00 1½ — 20.00 — 20.00 2 — 25.00 — 25.00 2½ — 35.00 — 35.00 3 — 50.00 — 50.00 3½ — 65.00 — 97.50 4 — 80.00 — 120.00 4½ — 100.00 — 150.00 5 — 125.00 — 187.50 6 — 150.00 — 225.00	*Cap., Tons* — *Tires* — *Fee* 1 or less — Pneu. — $10.00 2 — Pneu. — 15.00 3 — Pneu. — 25.00 4 — Pneu. — 40.00 5 — Pneu. — 50.00	Max. cap., 6 tons	.....	.....
CALIFORNIA (Motor Vehicle Dept.)	Amended 1921	Per hp. — $0.40 Electrics — $5.00	$0.40 per hp. plus the following: *Unladen Wt., Lb.* — *Fee* Less than 4,000 — $5.00 4,000–5,999 — 10.00 6,000–9,999 — 15.00 10,000 and over — 20.00	Trailers, each — $2.00	Max. gross wt., 30,000 lb. (for 4 wheels) Max. gross wt., 40,000 lb. for 6 wheels and 3 axles not less than 96 in. apart Per in. width tire base, 700 lb. (500 lb. for metal tires)	Width, 102 in.	City — 15 County — 35 *Trucks* *Gross Wt., Lb.* — *Speed* 9,000 — 25 9,001–12,000 — 15 12,001–24,000 — 10 Metal tires — 6
COLORADO (Sec'y of State)	Amended 1921	*Hp.* — *Fee* 20 or less — $2.50 21–40 — 5.00 41 or more — 10.00	*Cap., Tons* — *Fee* 1 — $10.00 >1–2 — 17.50 >2–3 — 25.00 >3–4 — 37.50 >4–5 — 50.00 For each add. ton over 5, 25.00	*Cap., Tons* — *Fee* 1–<2 — $10.00 For each additional ton, $5	Max. gross wt., 8 tons	.....	Country — 35
CONNECTICUT (Commissioner of Motor Vehicles)	Amended 1921 (Fees effective Jan. 1, 1922)	Per cu.in. total piston displacement — $0.08 (Min. fee, $15) Electric, per hp. — $0.75 Steam, per hp. — .75	*Cap., Tons* — *Fee* Pneu. — *Fee* Solid 1 or less — $22.50 — $30.00 1½ — 30.00 — 40.00 2 — 37.50 — 50.00 2½ — 60.00 — 60.00 3 — 70.00 — 70.00 3½ — 90.00 — 90.00 4 — 137.50 — 137.50 4½ — 162.50 — 162.50 5 — 187.50 — 187.50 5½ — 218.75 — 218.75 6 — 250.00 — 250.00 For each ton over 6 $100 addit'l (Min. fee, $22.50)	.....	Per in. width of tire, 800 lb. Not less than 20 per cent of gross load on one axle.	.....	City — 30 Country — 20 Solid tire truck — 15
DELAWARE (Sec'y of State)	1919	Per 500 lb. gross wt. — $2.00 (Passengers to be included at 125 lb. each)	Same as for passenger cars	Same as for passenger cars except that for metal tires double fees are charged if gross wt. exceeds 1,500 lb.	Max. gross wt., 26,000 lb. Per in. width of tire, 700 lb. For trailers with metal tires max. gross wt., 6,000 lb.	Width, 96 in. Height, 12 ft., 2 in. (Width for traction engines, 108 in.)	City — 15 Country — 30 *Gross Wt., Lb.* — *Country* — *City* *Pneumatic Tires* 6,000 — 30 — 15 8,000 — 25 — 15 12,000 — 25 — 15 16,000 — 25 — 15 20,000 — 22 — 12 26,000 — 20 — 12 *Solid Tires* 6,000 — 25 — 15 8,000 — 20 — 12 12,000 — 18 — 12 16,000 — 16 — 12 20,000 — 15 — 12 26,000 — 15 — 12

State and Vehicle Authority	Date of Act and Amendments	License Fees: Passenger Cars	License Fees: Motor Trucks	License Fees: Trailers	Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
FLORIDA (State Comptroller)	Effective Jan. 1, 1919	*Hp.* — *Fee* 22 and less — $5.00 > 22–27 — 8.00 > 27–35 — 12.00 Over 35 — 15.00	*Cap., Tons* — *Fee* 1 or less — $10.00 > 1–2 — 25.00 > 2–4 — 50.00 Over 4 — 100.00	No license for *one* trailer under 500 lb. capacity. If more than one or over 500 lb. capacity, fees same as trucks			25
GEORGIA (Sec'y of State)	Amended 1919	23 hp. or less — $11.25 Over 23 hp., per hp. — .60	*Cap., Tons* — *Fee* 1 or less — $15.00 > 1–1½ — 22.50 > 1½–2 — 30.00 > 2–2½ — 37.50 > 2½–3 — 45.00 > 3–3½ — 52.50 > 3½–4 — 75.00 > 4–5 — 150.00 > 5–6 — 375.00 > 6–7 — 750.00 Over 7 — 1,125.00	.....	.....	.....	Max. — 30
IDAHO (Sec'y of State)	Amended 1921	*Wt. of Vehicle, Lb.* — *Fee* 2,000 or less — $15.00 2,001–3,000 — 20.00 3,001–4,000 — 30.00 Over 4,000 — 40.00	Same as passenger cars	Same as passenger cars	Per in. width tire, 500 lb. (For tires less than 2 in wide max. load is 350 lb. per in. width) No vehicle load to exceed 50 per cent heavier than mfg'rs rating	.....	Max. — 30
ILLINOIS (Sec'y of State)	Effective Jan. 1, 1926	*Hp.* — *Fee* 25 and less — $8.00 26–35 — 12.00 36–50 — 20.00 Over 50 — 25.00 Electrics — 12.00	*Gross Wt., Lb.* — *Fee* 5,000 or less — $12.00 5,001–12,000 — 22.50 12,001–15,000 — 35.00 Over 15,000 — 60.00 Tractors — 25.00	.....	Per in. width tire, 800 lb. Per axle, 16,000 lb. (Within cities of 20,000 above limits increased 50 per cent)	Width, 8 ft. Length, trailer combination, 65 ft.	*Passenger Cars* City — 10–20 Country — 30 *Trucks* *Gross Wt., Lb.* — *Tires* — *Mi. p. H* 5,000 — Pneu. — 25 5,000 — Solid — 20 5,001–12,000 — Pneu. — 20 5,001–12,000 — Solid — 15 12,001–15,000 — Pneu. — 15 12,001–15,000 — Solid — 12 Over 15,000 — 12
INDIANA	Amended March, 1921	*Hp.* — *Fee* Less than 25 — $5.00 25–39 — 8.00 40–49 — 20.00 50 or more — 30.00 Electrics — 5.00	*Cap., Tons* — *Fee* Less than 1 — $6.00 1–<2 — 15.00 2–<3½ — 25.00 3½–<5 — 50.00 5–7½ — 75.00	*Cap., Tons* — *Fee* Under 1 — $3.00 1–<2 — 6.00 2–<5 — 10.00 5–7½ — 20.00	Max. cap., 7½ tons	.....	City — 10–15 Country — 25
IOWA (Motor Vehicle Dept.)	Amended 1921	Per 100 lb. wt. — $0.40 Plus 1% of value of vehicle Minimum fee — $10.00	*Cap., Tons* — *Pneu.* — *Fee Solid* 1 or less — $15.00 — $15.00 1½ — 22.50 — 22.50 2 — 30.00 — 30.00 2½ — 45.00 — 55.00 3 — 65.00 — 75.00 3½ — 90.00 — 100.00 4 — 105.00 — 115.00 4½ — 120.00 — 130.00 5 — 135.00 — 145.00 6 — 165.00 — 175.00 Per ton over 6 — 50.00 — 50.00 (Note.—Trucks over 2-ton capacity in city limits pay two-thirds above fees) For steel tires: 1-ton capacity — $40.00 1½-ton capacity — 50.00	*Cap., Tons* — *Fee* *Pneu.* — *Solid* — *Metal* 1 or less — $10 — $10 — $15 2 — 15 — 15 — 30 3 — 25 — 35 — ... 4 — 40 — 50 — ... 5 — 50 — 60 — ... 6 — 60 — 70 — ...	Per in. width tire, 800 lb. Max. gross wt., 14 tons Max. load, one wheel, 4 tons	Width, 8 ft.	*Gross Wt. Tons* — *Tires* — *Speed* Less than 3 — Pneu. — 30 Less than 3 — Solid — 25 >3–6 — Pneu. — 25 >3–6 — Solid — 20 >6 — Pneu. — 16 >6 — Solid — 12 Metal — 10
KENTUCKY	Enacted March, 1920	Per hp. — $0.60	*Cap., Lb.* — *Fee* 1,000 or less — $22.00 1,001–2,000 — 30.00 2,001–3,000 — 40.00 3,001–4,000 — 50.00 4,001–5,000 — 60.00 5,001–6,000 — 70.00 6,001–7,000 — 90.00 7,001–8,000 — 110.00 8,001–9,000 — 130.00 9,001–10,000 — 150.00 Over 10,000 — 150.00 Plus $50 for each add'l ton	.....	Per in. width tire: Rubber, 800 lb. Steel, 500 lb.	.....	*Passenger Cars* City — 15–20 Country — 30 *Trucks*—Rubber tires: *Cap., Tons* — *City* — *Country* 1 — 10–15 — 25 1–2½ — 7–14 — 20 >2½ — 7–11 — 15 Metal tires — 6–8 — 10

State and Vehicle Authority	Date of Act and Amendments	License Fees: Passenger Cars	License Fees: Motor Trucks	License Fees: Trailers	Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
KANSAS	.....	All cars $5 each	All trucks $5 each				
LOUISIANA (Sec'y of State)	Revised to July 11, 1918 New law pending	Per hp ..... $0.25 Min. fee 5.00	Per truck $7.50				
MAINE (Sec'y of State)	Revised to Jan. 1, 1920	*Hp* — *Fee* 15 or less ..... $5.00 > 15–35 ..... 10.00 > 35 ..... 15.00	*Cap., Tons* — *Fee* — *Cap., Tons* — *Fee* 1 or less — $10.00 — > 6–7 — $80.00 > 1–2 — 20.00 — > 7–8 — 95.00 > 2–3 — 30.00 — > 8–9 — 110.00 > 3–4 — 40.00 — > 9–10 — 125.00 > 4–5 — 50.00 > 5–6 — 65.00 Traction engines and log haulers, $10 each	.....	Per in. width tire, 800 lb. Max. gross wt., 9 tons	.....	*Passenger Cars* City ..... 15 Country ..... 25 *Trucks* *Gross Wt., Tons* — *Speed* > 4–6 ..... 15 > 6 ..... 6* * Solid tires
MARYLAND (Commissioner of Motor Vehicles)	Amended 1920	Per hp (pneu. tires) .. $0.60 (Min. fee $10)	*Solid Tires* *Cap., Tons* — *Fee* 1 or less ..... $20.00 2 or less ..... 40.00 3 or less ..... 60.00 4 or less ..... 100.00 5 or less ..... 150.00 6 or less ..... 300.00 7 or less ..... 500.00 *Pneu. Tires*—Same as passenger cars For electric solid tire vehicles one-half of above fees For tractors $25.00	*Rubber Tires* For first ton of cap. .. $10 For each additional ton, $20 *Metal Tires* Double above fees	Per in. width tire, 650 lb. Max. gross wt., trucks, 10 tons	Width, 90 in. (Traction engines may be 100 in. wide)	*Solid Tires* *Gross Wt., Tons* — *Mi. per H* 2 or less ..... 25 > 2–6 ..... 15 Over 6 ..... 12 *Metal tires* ..... 6 *Pneu. Tires* City ..... 15–20 Country ..... 35 Max. speed for any vehicle with commercial body and gross wt. over 3 tons, 25
MASSACHUSETTS (Registrar of Motor Vehicles Dept. Pub. Works)	Acts of 1909 amended to Aug., 1920	*Hp* — *Fee* Less than 30 ..... $10.00 30–39 ..... 15.00 40–49 ..... 20.00 50 and over 25.00	*Cap., Tons* — *Fee* 1 or less ..... $10.00 > 1–2 ..... 20.00 > 2–3 ..... 30.00 > 3–4 ..... 40.00 > 4–5 ..... 50.00 For each ton over 5 tons .. 10.00 Electric trucks pay one-half above rates	Solid rubber tires, same as trucks Metal tires, double truck rates Pneu. tires, one-half truck rates for solid tires	Per in. width tire, 800 lb. Max. gross wt., 28,000 lb.	Width, 96 in. Length, 28 ft. Length, trailer combination, 65 ft.	*Passenger Cars* City ..... 15 Country ..... 20 *Trucks and Trailers* *Gross Wt., Tons* — *Tires* — *Speed* Over 4 .... Rubber — 15 Over 4 .... Metal — 4
MICHIGAN (Sec'y of State)	Revised, 1921	*Gasoline and Steam Fee* Per hp ..... $0.25 Per 100 lb. unladen wt. .35 *Electric* Per hp ..... $1.00 Per 100 lb. wt. ..... .35	Same as passenger cars	Per 100 lb. of its wt. $0.50	*Trucks and Trailers* *Size of Tire, In.** — *Max. Wheel Load, Lb.* 2 ..... 700 2½ ..... 900 3 ..... 1,200 3½ ..... 1,600 4 ..... 1,900 5 ..... 2,200 6 ..... 2,700 7 ..... 3,200 *Above scale for 32-in. diam. wheel. Add 1/10 for each 2-in. increase in wheel diam. Max. gross wt., 15 tons	Width, 96 in. Height, 12 ft., 6 in. Trailer combin., 60 ft.	*Passenger Cars* City ..... 15 Country ..... 35 *Trucks* *Single Tire Wheel* — *Double Tire Wheel* *Load, Lb.* — *Speed* — *Load, Lb.* — *Sp'd* 700 — 20 — 1,400 — 18 900 — 20 — 1,800 — 18 1,200 — 20 — 2,400 — 18 1,600 — 20 — 3,200 — 16 1,900 — 18 — 3,800 — 14 2,200 — 16 — 4,400 — 13 2,700 — 14 — 5,400 — 12 3,200 — 12 — 6,400 — 10
MINNESOTA	Amended 1921	Each vehicle, 2 per cent of its value Min. fee for less than 2,000 lb. wt., $12 Min. fee for more than 2,000 lb. wt., $15	Each vehicle, 2 per cent of its value Min. fee for less than 2-ton cap., $15 Min. fee for 2 to 4 tons, $30 Min. fee over 4 tons, $50	Min. fee, $2 per ton of cap.	Per in. width tire, 800 lb. Max. gross wt., 28,000 lb. Max. wt., 1 axle, 22,400 lb.	Width, 96 in. Height, 12 ft., 6 in. Length, 30 ft. Trailer combination, 85 ft.	
MISSISSIPPI (Automobile Dept.)	Effective April 2, 1920	Per hp ..... $0.50 Electric ..... 15.00 (Min. fee, $5)	*Cap., Tons* — *Fee* Under 1 ..... $10.00 1 and 1½ ..... 15.00 2 ..... 30.00 2½ ..... 35.00 3 ..... 55.00 3½ ..... 75.00 4 ..... 115.00 4½ ..... 155.00 5 ..... 200.00 6 ..... 250.00 > 6 ..... 300.00	.....	.....	.....	City ..... 15 Country 30

State and Vehicle Authority	Date of Act and Amendments	License Fees: Passenger Cars	License Fees: Motor Trucks	License Fees: Trailers	Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
MISSOURI (Sec'y of State)	.....	*Hp.* — *Fee* 2 or less ..... $2.00 > 2–11 ..... 4.00 12–23 ..... 6.00 24–35 ..... 10.00 36–47 ..... 14.00 48–59 ..... 16.00 60–71 ..... 20.00 72 and over 24.00	Same as passenger cars				Max 25
MONTANA (Sec'y of State)	Approved Mar. 5, 1921	*Hp.* — *Fee* 23 or less ..... $7.50 > 23–37 ..... 15.00 > 37 ..... 22.50 Electric 15.00	*Cap. tons* — *Fee* 1 or less ..... $10.00 > 1-2 ..... 22.50 > 2-3 ..... 37.50 Over 3 ..... 60.00	.....	.....	.....	City ..... 15 Country 25
NEBRASKA (Motor Vehicle Dept.)	Act of April 11, 1919	Wt., unladen, 1 ton .. $10.00 For each additional 100 lb. wt. of car .. .50 (Min. fee $10)	Gross wt. 1 ton ..... $10.00 For each additional 100 lb., gross wt ..... .50	.....	Per in. width tire, 600 lb. *On one wheel, 7,000 lb. *D. P. W. traffic regul.	*Width, 7½ ft. *Height, 12 ft. *D. P. W. traffic regul.	Max 35
NEVADA	1921	Per 100 lb. factory wt. plus wt. of passengers at 125 lb. each, $0.35	Per 100 lb. gross wt $0.35	Same as motor trucks and buses, if operating on established line	.....	.....	.....
NEW HAMPSHIRE (Commissioner of Motor Vehicles)	Approved April 13, 1921	Per 100 lb. gross wt. $0.60 (Passengers figured at 150 lb. each) (Min. fee, $15)	*Per 100 Lb. Gross Wt.* — *Fee* Pneu. tires ..... $0.60 (Min., $20) Solid tires ..... .85 (Min. $30) Iron or steel tires 1.00	*Per 100 Lb. Gross Wt.* — *Fee* Pneu. tires ..... $0.50 Solid tires ..... .65 Metal tires ..... .90	Per in. width tire, 750 lb. Max. gross wt., 20,000 lb. Max. wt., one axle, 15,000 lb.	Width, 96 in. Length, 30 ft. Trailer comb., 85 ft.	.....
NEW JERSEY (Dept. of Motor Vehicles)	Amended 1921	*Hp.* — *Fee per Hp.* 0–29 ..... $0.40 30 or more ..... .50	*Gross Wt., Lb.* — *Fee* 1,000 or less ..... $10.00 1,001–2,000 ..... 12.00 2,001–3,000 ..... 15.00 3,001–4,000 ..... 20.00 4,001–5,000 ..... 24.00 (The scale from this point increases $3 for each additional 1,000 lb.) 29,001–30,000 ..... 99.00	Same as trucks	Per in. width tire, 800 lb. Max. gross wt., 30,000 lb. (Table compiled for wheel loads for various sizes of tire and wheel)	Width, 96 in. Length, 28 ft. Height, 12½ ft. Trailer comb., 85 ft.	*Passenger Cars* City ..... 12 Country ..... 30 *Trucks* *Gr. Wt., Tons* — *Speed* > 4–6 ..... 16 > 6–8 ..... 14 > 8–15 10
NEW MEXICO		Per hp $0.40	Per hp $0.50				
NEW YORK (State Tax Commission)	Amended 1921	Per hp ..... $0.25 *Additional Fee* Years after Date of Mfg. — Per $100 of List Price 3 ..... $0.40 4–5 ..... .20 Over 5 ..... .10 Min. fee (4-cyl.) .. 5.00 Min. fee (6-cyl. or more) 10.00	*Gross Wt., Tons* — *Fee* 2 or less ..... $10.00 > 2– 3 ..... 15.00 > 3 –4 ..... 20.00 > 4– 5 ..... 25.00 > 5– 6 ..... 30.00 > 6– 7 ..... 35.00 > 7– 8 ..... 40.00 > 8– 9 ..... 45.00 > 9–10 ..... 50.00 > 10–11 ..... 55.00 > 11–12 ..... 60.00 > 12–13 ..... 65.00 > 13–14 ..... 70.00 Over 14 ..... $70 plus $10 for each ton over 14	*Gross Wt., Tons* — *Fee* 2 or less ..... $5.00 > 2–5 ..... 10.00 > 5–7 ..... 15.00 > 7–10 ..... 20.00 > 10–14 ..... 30.00 Over 14 ..... 30.00 Plus $5 for each ton over 14	Per in. width tire, 800 lb. Max. gross wt., 25,000 lb.	Width, 8 ft. Height, 12 ft., 6 in.	Max 30
NORTH CAROLINA (Sec'y of State)	1921 (Effective July 1, 1921)	*Hp.* — *Fee* 24 or less ..... $12.50 25–30 ..... 20.00 31–34 ..... 30.00 35 or more 40.00	*Cap., Tons* — *Fee* Under ½ ..... $12.50 ½–less than 1 ..... 15.00 1–less than 2 ..... 25.00 2–less than 3 ..... 75.00 3–less than 4 ..... 200.00	$15 per ton carrying cap.	.....	.....	.....

State and Vehicle Authority	Date of Act and Amendments	License Fees: Passenger Cars	License Fees: Motor Trucks	License Fees: Trailers	Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
NORTH DAKOTA Motor Vehicle Dept.)	Amended 1920	*For first year* Per dollar list price..$0.005 Per 100 lb wt. ..... .20 Per hp ..... .10 Electrics pay $2 in lieu of hp. fee *For second year*, 10 per cent reduction from basic fee *For third year*, 25 per cent reduction; and thereafter 40 per cent reduction (Min. fee, ($5)	*In addition* to passenger car fees trucks pay following: *Capacity* — *Fee* Per ton (up to 3) ..... $3.00 Per ton (3–4) ..... 5.00 Per ton (> 4) 10.00	.....	.....	.....	City ..... 10 Country 30
OHIO (Sec'y of State)	Amended 1921	*Hp.* — *Fee* 25 or less ..... $8.00 26–35 ..... 12.00 Over 35 ..... 20.00 *Electric* 8.00	*Gasoline* Same as for passenger cars, plus $0.20 per 100 lb. gross wt. *Electric* A fee of $8, plus 20 cents per 100 lb. gross wt.	Per 100 lb gross wt...$0.20	Max. gross wt., 10 tons for trucks and 12 tons for traction engines Per in. width of tire: Steel (3 in.), 500 lb. Rubber, 650 lb. Per axle, 14,000 lb. Load on one wheel not more than 35% of total gross wt.; on one axle, not more than 70 per cent of gross wt.	Width, 96 in. Height, 12 ft., 6 in. Length, 30 ft. Trailer combination, 85 ft.	*Passenger Cars* City ..... 15–20 Country ..... 30 *Trucks* *Gross Wt. Tons* — *Solid* — *Pneu.* <5 ..... 20 — 25 5–8 ..... 15 — 20 >8–10 ..... 12 — 15
OKLAHOMA (Dept. of Highways)	Effective Jan. 1, 1920	*List Price* — *Fee* $500 or less ..... $10.00 Over $500 additional 75c. for each $100 of list price	*Cap., Lb.* — *Fee* 1,500 or less ..... $15.00 1,500–1,999 ..... 20.00 2,000–2,999 ..... 25.00 3,000–3,999 ..... 40.00 4,000–5,999 ..... 60.00 6,000–7,999 ..... 100.00 8,000 and over ..... 300.00 (Reduction of 20 per cent each year for 3 years on vehicles, except of 5 tons or more capacity, which have been licensed for 2 years) (Min. fee, $10)	.....	.....	.....	.....
OREGON (Dept. of State, Motor Vehicle Division)	Amended 1921	*Wt., Lb.* — *Fee* 1,700 or less ..... $15.00 1,701–2,100 ..... 21.00 2,101–2,500 ..... 28.00 2,501–2,900 ..... 34.00 2,901–3,300 ..... 40.00 3,301–3,700 ..... 47.00 3,701–4,100 ..... 55.00 4,101–4,500 ..... 62.00 4,501–4,900 ..... 71.00 4,901–5,300 ..... 79.00 5,301–5,700 ..... 88.00 Over 5,700 ..... 97.00 Electrics 25.00	*Solid Tires* *Total tire width, in.* — *Fee* 14 or less ..... $35.00 > 14–17 ..... 42.00 > 17–22 ..... 55.00 > 22–26 ..... 65.00 > 26–30 ..... 105.00 > 30–36 ..... 126.00 > 36–40 ..... 140.00 *Pneumatic tires* *Total Tire Width, In.* — *Fee* 20 or less ..... $35.00 > 20–24 ..... 42.00 > 24–28 ..... 49.00 > 28–32 ..... 56.00 > 32–40 ..... 70.00 Electric trucks 35.00	*Solid Tires* *Total Tire Width, In.* — *Fee* 14 or less ..... $17.50 14–17 ..... 21.00 >17–22 ..... 27.50 >22–26 ..... 32.50 >26–30 ..... 52.50 >30–36 ..... 63.00 >36–40 ..... 70.00 *Pneumatic Tires* *Total Tire Width, In.* — *Fee* 20 or less ..... $17.50 >20–24 ..... 21.00 >24–28 ..... 24.50 >28–32 ..... 28.00 >32–40 ..... 35.00	Max. gross wt., 22,000 lb. Max. gross wt. per axle, 17,600 lb. *Per Inch Width of Tire* 500 lb. if total tire width for all wheels is less than 30 in. 600 lb. if total tire width for all wheels is 30 in. or more. Max. for metal tired vehicle (gross wt.), 6,500 lb. on hard surfaced highways For device not equipped with wheels, max. gr. wt., 22,000 lb.	Width, 8 ft.	City ..... 20 Country ..... 30 *Fees* *Gr. Wt., Lb.* — *Pneu.* — *Solid* — *Metal* 6,500 ..... 30 — 25 — 8 9,500 ..... 25 — 20 — 8 12,500 ..... 22 — 18 — 8 16,500 ..... 20 — 15 — 8 22,000 ..... 18 — 12 — 8
PENNSYLVANIA (State Highway Dept.)	Amended 1921	Per hp ..... $0.40 (Min. fee, $10)	*Wt. of Chassis, Lb.* — *Fee: Pneu.* — *Solid* <2,000 ..... $15.00 — $15.00 2,000–2,999 ..... 24.00 — 30.00 3,000–3,999 ..... 32.00 — 40.00 4,000–4,999 ..... 40.00 — 50.00 5,000–5,999 ..... 56.00 — 70.00 6,000–7,499 ..... 80.00 — 100.00 7,500–8,499 ..... 100.00 — 125.00 8,500 and over ..... 140.00 — 200.00	.....	Per in. width tire, 800 lb. Max. gross wt., 26,000 lb. Max. wt., 1 axle, 19,500 lb.	Width, 96 in. Length, 28 ft.	Passenger cars, 30 max. *Trucks* *Wt. of Chassis, Lb.* — *Pneu.* — *Solid* <2,000 ..... 26 — 24 2,000–2,999 ..... 24 — 20 3,000–3,999 ..... 24 — 20 4,000–4,999 ..... 22 — 18 5,000–5,999 ..... 19 — 15 6,000–7,499 ..... 19 — 15 7,500–8,499 ..... 16 — 12 8,500 and over ..... 14 — 10

State and Vehicle Authority	Date of Act and Amendments	License Fees — Passenger Cars	Motor Trucks	Trailers	Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
RHODE ISLAND (State Board of Public Roads)	Passed 1921	Fee Tires — Per Hp. — Per 100 Lb. Gross Wt. Pneu. — $0.25 — $0.25 Solid rub. — .25 — .35 Steel — .25 — .50	Same as passenger cars	Fee, per Tires — 100 Lb. Gross Wt Pneu. — $0.15 Solid — .25 Metal — .35			
SOUTH CAROLINA	Effective Jan. 1, 1921	Wt. of Vehicle, Lb. — Fee 2,000 or less — $6.00 Each additional 500 lb — 2.00	Cap., Tons — Fee 1 or less — $15.00 >1–2 — 30.00 >2–3 — 60.00 >3–4 — 100.00 >4–5 — 200.00 >5–6 — 250.00 >6–7(+) — 350.00 Reduction of 25 per cent for pneu. tires	Per trailer, $5 Plus $2 per 1,000 lb. of capacity	4-ton truck the limit, except in case of special permit	Width, 7½ ft.	
SOUTH DAKOTA (Sec'y of State)	Effective Jan. 1, 1920	All cars, $6 each	Cap., Tons — Fee 2 or less — $6.00 >2–3½(—) — 10.00 3½ or more — 15.00				
TENNESSEE (State Highw'y Dept.)	Effective April 21, 1919	Per hp — $0.50 Electrics (each) — 25.00	Per hp. — $0.50 Plus $5 per ton of carrying capacity. Electric $25 plus $5 per ton of carrying capacity				
TEXAS (State Highw'y Dept.)	Effective Jan. 1, 1922	Per hp — $0.35 (Min. fee $7.50)	Cap., Lb. — Fee 2,001–4,000 — $30.0 4,001–6,000 — 50.00 6,001–8,000 — 80.00 8,001–10,000 — 120.00 *Tractors* Tires — Per 100 Lb. Weight Pneu. — $0.25 Solid rub — .35 Metal — .50 *Mileage Tax (Counties)* Cap., Lb. — License Fee, Per Mile 2,001–3,999 — 1c. 4,000–5,999 — 2c. 6,000–7,999 — 3c. 8,000–9,999 — 5c. 10,000–11,999 — 8c.	Tires — Per 100 Lb. Gross Wt. Pneu. — $0.15 Solid — .25 Metal — .35	Per in. width tire, 500 lb Per wheel, 5,000 lb	Width, 7 ft.	Gross Wt. Lb. — Tires — Mi. per Hr 4,000 — Pneu — 15 4,000 — Solid — 14 6,000 — Pneu — 12 6,000 — Solid — 10 8,000–20,000 — Pneu — 10 8,000–20,000 — Solid — 10
UTAH (Sec'y of State)	Amended 1921	Hp. — Fee 25 or less — $10.00 26–40 — 15.00 41–50 — 20.00 Over 50 — 25.00 Electrics — 15.00 Steam vehicles of 15 hp. or less — 10.00 Of 16–25 hp — 15.00	Fee Cap., Tons — Pneu. — Solid 1 or less — $20.00 — $27.50 1½ — 25.00 — 35.00 2 — 30.00 — 45.00 2½ — 35.00 — 55.00 3 — 45.00 — 65.00 3½ — 55.00 — 80.00 4 — 65.00 — 100.00 4½ — 75.00 — 120.00 5 — 90.00 — 140.00 Over 5—$50 per ton additional For metal-tired motor trucks: Cap. 1 ton — $40.00 Cap. 1½ ton — 60.00 Cap. 2 tons — 80.00	*Pneumatic Tires* Cap., Tons — Fee 1 or less — $10.00 2 or less — 15.00 3 or less — 25.00 4 or less — 40.00 5 or less — 50.00 *Solid Tires* Cap., Tons — Fee 1 or less — $15.00 2 or less — 25.00 3 or less — 40.00 4 or less — 60.00 5 or less — 75.00 *Metal Tires* Cap., Tons — Fee ½ — $15.00 1 — 25.00 2 — 50.00	Max. load, one wheel, 3½ tons Max. gross wt., 11 tons *Per in. width tire* Hard surf. pav'ts, 600 lb Earth and gravel, 400 lb	Width, 8 ft.	Gross Wt., Tons — Tires — Mi. per Hr Under 3 — Pneu. — 30 Under 3 — Solid — 20 3–4 — Pneu. — 25 3–4 — Solid — 15 Over 4 — Pneu. — 16 Over 4 — Solid — 8 For metal tired vehicles, max. speed is 5 mi. per hr.
VIRGINIA (Sec'y of Commonwealth)	Code of 1919	Per hp. — $0.60 (Min. fee $10)	Cap. 1 ton — $15.00 Each add'l 1,000 lb. cap. — 5.00	Cap., 1 ton — $10.00 Ea. add'l 1,000 lb — 3.00	Max. gross wt., 24,000 lb Per in. width tire, 700 lb.		City — 10 Country — 20

State and Vehicle Authority	Date of Act and Amendments	License Fees: Passenger Cars	License Fees: Motor Trucks	License Fees: Trailers	Weight Limits	Dimension Limits	Speed Limits (Miles per Hour)
VERMONT Sec'y of State)	Amended 1921	*Fee per Hp.* First year ..... $1.00 Second year ..... .75 Third year ..... .50 Subsequent year .... .50	*Cap., Tons* — *Fees* ¾–1 ..... $20.00 >1 –1½ ..... 30.00 >1½–2 ..... 40.00 >2–2½ ..... 50.00 >2½–3 ..... 75.00 >3 –4 ..... 100.00 For each add'l ton or fraction over 4 ..... 25.00	.....	Per in. width tire, 600 lb. Max. gross wt., 6½ tons (Except where written permit is granted)	Width, 8 ft. Height, 12 ft., 2 in.	On bridges ..... 10 *Gross Wt.* — *Speed* 4 tons ..... 15 >6 tons 12
WASHINGTON (Sec'y of State)	Amended 1921	*Passenger Cars (Private)* *Weight* — *Fee* 1,500 lb. or less .... $10.00 Over 1,500 lb. ..... 10.00 Plus 60 cents per 100 lb. over 1,500 *Passenger Cars (for Hire)* *Weight* — *Fee* 1,500 lb. or less .... $20.00 Plus $3 per person carrying capacity Over 1,500 lb. ..... $20.00 Plus 60 cents per 100 lb. over 1,500, plus $3 per person carrying capacity	*Weight* — *Fee* 1,500 lb. or less ..... $10.00 1,500–6,500 ..... 10.00 Plus 40 cents per 100 lb. over 1,500 lb., plus 40 cents per 100 lb. of rated carrying capacity. Over 6,500 lb. ..... $10.00 Plus 50 cents per 100 lb. over 1,500, plus 50 cents per 100 lb. rated carrying capacity	*Auto Stage Trailers* Wt. 1,500 lb. or less $10.00 Plus $3 per person carrying capacity Wt. over 1,500 lb. .... $10.00 Plus 60 cents per 100 lb. over 1,500 lb., plus $3 per person carrying capacity *Truck Trailers* Same as motor trucks	Per in. width tire, 800 lb. Max. gross wt. 24,000 lb. Max. wt. one axle, 22,400 lb.		*Passenger Cars* City ..... 12–20 Country ..... 30 *Motor Trucks (Solid Tires)* *Gross Wt., Tons* — *Speed* 2 and less ..... 25 2– 4 ..... 20 4– 6 ..... 18 6– 8 ..... 16 8–10 ..... 14 10–12 ..... 12 *Motor Trucks (Pneu. Tires* 25 mi. per hr.) *Stages* (10 Passengers) 25 mi. per hr.
WEST VIRGINIA (State Road Commission)	Enacted 1921	*Pneumatic Tires* Per hp. ..... $0.30 Per 100 lb. gross wt. .. .30 (Passenger wt. at 125 lb. each)	*Solid Tires* *Cap., Tons* — *Fee* 1 or less ..... $25.00 >1–2 ..... 50.00 >2–3 ..... 75.00 >3–4 ..... 100.00 >4–5 ..... 150.00 1 neu. tires, same as passenger cars *Tractors Drawing Trailers* *Gr. Wt. Tons* — *Fee* — *Gr. Wt. Tons* — *Fee* 2 or less $20.00 — >6 –6½ $80.00 >2 –2½ 25.00 — >6½–7 90.00 >2½–3 30.00 — >7–7½ 100.00 >3–3½ 35.00 — >7½–8 110.00 >3½–4 40.00 — >8–8½ 120.00 >4–4½ 45.00 — >8½–9 130.00 >4½–5 50.00 — >9–9½ 140.00 >5–5½ 60.00 — >9½–10 160.00 >5½–6 70.00 — 11 ..... 180.00	*Cap., Tons* — *Fee* 1 or less ..... $10.00 Each add. ton ..... 15.00 (For pneu. tires, fees are one-half above)	Per in. width tire, 600 lb. Max. gross wt., 22,000 lb. Max. gross wt., 1 axle, 17,000 lb. Max. gross wt., 1 wheel, 9,000 lb.	Width, 90 in. Height, 12 ft. Length, 30 ft. Trailer combination, 60 ft.	*Vehicle* — *Gr. Wt.* — (1) (2) 7-pass. ..... 6,000 — 35 15 Others (pn. trs.) — 25 15 Solid tires .... 4,000 — 20 10 Solid tires .... >4,000 — 15 10 Steel tires .... >2,000 — 5 5 (1) Country (2) City
WISCONSIN	.....	All cars $10 each	*Cap., Lb.* — *Fee* Under 2,100 ..... $15.00 2,100–5,099 ..... 20.00 5,100 or more 25.00	.....	Per in. width tire, 800 lb. Max. gross wt., 24,000 lb. Max. per axle, 18,000 lb.	Width, 96 in. Length, 30 ft. Trailer comb., 100 ft. in large cities	.....
WYOMING (Sec'y of State)	Effective Jan. 1, 1921	Per hp. $0.40	Per 100 lb. wt. of vehicle, $0.75	.....	.....	.....	.....
Proposed Uniform Vehicle Law (Vehicle Commissioner)	Jan. 20, 1920	*Motor Vehicles* — *Per Hp.* — *Per 100 Lb. Gross Wt.* Pneu. tires .... $0.25 — $0.25 Solid tires ..... .25 — .35 Metal tires ..... .25 — .50 *Tractors* Pneu. tires ..... .25 — .25 Solid tires ..... .25 — .35 Metal tires ..... .25 — .50 Agric. tractors pay 1/10 above	Same as for passenger cars	*Per 100 Lb. Gross Wt.* Pneu. tires ..... $0.15 Solid tires ..... .25 Metal tires ..... .35	Per in. width tire, 800 lb. Max. gross wt. (4 wheels), 28,000 lb. Max. wt., 1 axle, 22,400 lb.	Width, 96 in. Height, 12 ft., 6 in. Length, 30 ft. Trailer combination, 85 ft.	*Passenger Cars* Under 6,000 lb. gross wt. Country ..... 30 City ..... 15 *Trucks* Pneu. tires City ..... 15 Country ..... 25 *Solid tires City ..... 12–15 Country ..... 15–25 *Wts., 4,000 to 28,000 lb.

developed 23 hp., cost $2,700, and weighed, unloaded, 4,700 lb.; the 3½-ton truck showed a horsepower of 31, cost $4,800, and weighed, unloaded, 8,800 lb.; the 5-ton truck showed 34 hp., cost $5,800, and weighed, unloaded, 10,700 lb. In the case of each truck the weight and cost includes the body.

TABLE IV. COMPARISON OF STATE LICENSE FEES FOR 25-HP PASSENGER CAR AND FOR 1, 1½, 3½ AND 5-TON TRUCKS

State	25-Hp. Passenger Car	1-Ton Truck (Pneu. Tires)	1½-Ton Truck (Solid Tires)	3½-Ton Truck (Solid Tires)	5-Ton Truck (Solid Tires)
Alabama	$18.75	$22.50	$22.50	$56.25	$75.00
Arizona	5.00	10.00	10.00	25.00	25.00
Arkansas	14.90	15.00	20.00	97.50	187.50
California	10.00	18.80	19.20	27.40	33.60
Colorado	5.00	10.00	17.50	37.50	50.00
Connecticut	18.00	22.50	40.00	90.00	187.50
Delaware	13.30	24.00	30.80	63.20	82.80
Florida	8.00	10.00	25.00	50.00	100.00
Georgia	15.00	15.00	22.50	52.50	150.00
Idaho	20.00	30.00	40.00	40.00	40.00
Illinois	8.00	22.50	22.50	60.00	60.00
Indiana	8.00	15.00	15.00	50.00	75.00
Iowa	27.60	15.00	22.50	100.00	145.00
Kansas	5.00	5.00	5.00	5.00	5.00
Kentucky	15.00	30.00	40.00	90.00	150.00
Louisiana	6.25	7.50	7.50	7.50	7.50
Maine	10.00	10.00	20.00	40.00	50.00
Maryland	15.00	15.00	40.00	100.00	150.00
Massachusetts	10.00	10.00	20.00	40.00	50.00
Michigan	15.70	19.50	22.20	38.55	44.95
Minnesota	33.60	48.00	54.00	96.00	116.00
Mississippi	12.50	15.00	15.00	75.00	200.00
Missouri	10.00	6.00	6.00	10.00	10.00
Montana	15.00	10.00	22.50	60.00	60.00
Nebraska	13.50	30.00	38.50	79.00	103.50
Nevada	11.65	21.00	26.95	55.30	72.45
New Hampshire	20.70	36.00	65.45	134.30	175.95
New Jersey	10.00	27.00	33.00	57.00	72.00
New Mexico	10.00	11.00	11.50	15.50	17.00
New York	13.00	15.00	20.00	40.00	55.00
North Carolina	20.00	25.00	25.00	200.00	200.00
North Dakota	16.30	25.20	27.70	49.70	63.80
Ohio	8.00	20.00	23.40	43.60	53.40
Oklahoma	18.85	25.00	40.00	100.00	300.00
Oregon	34.00	20.00	55.00	105.00	126.00
Pennsylvania	10.00	32.00	40.00	100.00	200.00
Rhode Island	14.90	20.50	32.70	63.05	80.95
South Carolina	8.80	15.00	30.00	100.00	200.00
South Dakota	6.00	6.00	6.00	15.00	15.00
Tennessee	12.50	16.00	19.00	33.00	42.00
Texas	8.75	30.00	30.00	80.00	120.00
Utah	10.00	20.00	35.00	80.00	140.00
Vermont	25.00	20.00	30.00	100.00	125.00
Virginia	15.00	15.00	20.00	40.00	55.00
Washington	17.20	28.00	41.00	81.50	106.00
West Virginia	17.50	24.60	50.00	100.00	150.00
Wisconsin	10.00	15.00	20.00	25.00	25.00
Wyoming	10.00	30.00	35.25	66.00	80.25
Uniform Vehicle Law	14.90	20.50	32.70	63.05	80.95

A graphic comparison of the fees for motor vehicles of the several types covered in Table IV, is given in the accompanying diagrams, Figs. 1 to 5. Each dot represents a state in which the license fee for the particular vehicle in question is between the limits shown on the scale at the left of each diagram. There is also plotted on each diagram for purposes of comparison, the fee recommended in the proposed uniform vehicle law. In the case of a 25-hp. 5-passenger automobile it will be observed that the prevailing fee is between $10 and $15. In the case of motor trucks the prevailing fee for the 1-ton unit, equipped with pneumatic tires, is from $15 to $20; for the 1½-ton truck, from $20 to $25; for the 3½-ton truck, from $100 to $110; and for the 5-ton truck, from $50 to $60. The diagrams show convincingly how the range of license fees increases for the heavier capacity trucks.

Road Maintenance Funds Lost

Another point brought out, inferentially, by these diagrams is the large sum of money that is being lost for highway maintenance by reason of the fact that the scale of fees is frequently much less than that specified in the uniform vehicle law, in the preparation of which the representatives of the motor-vehicle manufacturers and users took a very considerable part. In the case of the 1-ton truck, for example, it will be seen that 24 states have license fees *lower* than those of the uniform vehicle law. For the 1½-ton truck a still greater number of states, 28, are below the uniform vehicle law mark. In the case of both 3½- and 5-ton trucks 24 states are failing to receive as high a fee as the motor vehicle interests themselves concede to be equitable in the uniform law. On the other hand, the fees in other states are considerably higher than the uniform law recommends. In some cases the fees for the heavier trucks, when one takes into consideration the destructive influence of these vehicles on the highway, are ridiculously low.

With $102,546,000 received from motor-vehicle registration and license fees, including those for chauffeurs, operators and dealers, in 1920, the state motor-vehicle fund, as revenue for highway maintenance, has reached considerable proportions. Of this amount, collected last year, according to the U. S. Bureau of Public Roads, $77,527,000 was used by or under the state highway departments and $20,144,000 under the direction of local authorities. Inasmuch as practically all of these funds, except a small percentage required for the administration of the motor-vehicle departments, go into highway work, it behooves the highway engineer to see that a fair scale of registration fees for both passenger automobiles and motor trucks is established. The increase in vehicular traffic has been so enormous during recent years that adequate funds for road maintenance must be supplied and used to best advantage if the staggering investment in the first cost of our highway systems is to be preserved. Motor vehicles are today the chief benefactors of good highways and should pay their just amount in order that the roads may be properly maintained. Motor-vehicle legislation and highway maintenance, therefore, are linked very closely.

Gross Weight Limitations

On the subject of the maximum gross weight (vehicle and load combined) which should be permitted on highways, state highway officials, motor truck manufacturers and users are far from agreement. The controversy is one of long standing and was one of the two main issues (the other being the measurement of tire width) on which the members of the joint committee on uniform vehicle laws failed to concur. As printed, the uniform law prescribes 28,000 lb. as the maximum gross weight, but to this provision the highway members of the committee dissented. The question is an exceedingly complex one. Truck manufacturers maintain, on the one hand, that lower transport costs are secured by the use of large truck units; highway engineers, on the other, contend that the large heavily loaded vehicles are the chief agents of road destruction and that the apparent lower transport costs with the big units are actually nullified by the higher road maintenance and reconstruction charges which their use creates.

At the annual meeting, May 13, of the National Highway Traffic Association at Ann Arbor, Mich., the committee on speeds, weights and dimensions of motor trucks (George H. Pride, president, Heavy Haulage Co., New York, chairman) reported in favor of a 28,000-lb. maximum gross weight and a 22,000-lb. maximum axle loading. The report states, however, that there was diversity of opinion among the members

of the committee as to permissible weight limits, but that the convention, by a large majority, favored the 14-ton figure.

While it is not possible to quote any weight limit officially representing the consensus of opinion of state highway officials, it is believed that, except in those states where the main highways are largely of gravel or earth, the 5-ton truck is regarded as the heaviest unit for which, in the present state of the art, highways can be economically constructed and maintained. In Maryland, one of the states which have been exceedingly active both in the passage and in the enforcement of motor vehicle laws, a gross-weight limit of 10 tons—

TABLE V. GROSS WEIGHT LIMITS

Max. Gross Wt., Tons	States
6½	Vt.
8	Colo.
9	Me.
10	Ala., Md., N. H., Ohio
11	Ore., Utah, W. Va.
12	Va., Wash., Wis.
12½	N. Y.
13	Del., Pa.
14	Ia., Mass., Minn.
15	Cal., Mich., N. J.

TABLE VI. AXLE LOAD LIMITS

Max. Wt., Lb.	States
14,000	Ohio
15,000	N. H.
16,000	Ill.
17,000	W. Va.
17,600	Ore.
18,000	Wis.
19,500	Pa.
22,400	Minn., Wash.

TABLE VII. WEIGHT LIMITS PER INCH WIDTH OF TIRE

Lb. per In. Width of Tire	States
500	Idaho, Ore., Tex.
600	Neb., Utah, Vt., W. Va.
650	Md., Ohio
700	Cal., Del., Va.
750	N. H.
800	Conn., Ill., Ia., Ky., Me., Mass., Minn., N. J., N. Y., Pa., Wash., Wis.

TABLE VIII. MAXIMUM WHEEL LOADS

Wt., Tons	States
2½	Tex.
3½	Neb.
3¾	Utah
4	Ia.
4½	W. Va.

TABLE IX. MAXIMUM TRUCK CAPACITIES

Cap., Tons	States
4	S. C.
5	Md.
6	Ark.
7½	Ind.

roughly equivalent to a loaded truck of 5 tons' carrying capacity—is prescribed.

The extreme case of low maximum limit is offered by Vermont, where existing laws limit the gross weight of a vehicle, except when special permits are issued, to 6½ tons. In Colorado the maximum is 8 tons and in Maine, 9 tons. Four states have a 10-ton limit; three states, 11 tons; three states, 12 tons; one state, 12½ tons; two states, 13 tons; three states 14 tons; and three states 15 tons. Fifteen tons is the highest gross weight limit prescribed and is in force in California, Michigan and New Jersey. About twenty states place no restrictions on gross weight.

In addition to, or as a substitute for a maximum gross weight specification, about half the states prescribe a maximum permissible loading per inch width of tire. This loading ranges from a minimum of 500 lb. in Idaho, Oregon, and Texas, up to 800 lb., the value recommended by the joint committee on uniform vehicle laws and adopted in a dozen or so states, including Connecticut, Illinois, Iowa, New Jersey, New York, Pennsylvania, Washington, Wisconsin, Minnesota, Massachusetts, Maine, Kentucky, and Iowa.

Tables V to IX, inclusive, summarize the various weight restrictions in the state laws.

Overloaded Trucks

The mere specification of a gross weight limit, however, is of little benefit unless some machinery is developed for its enforcement. In this respect many states are deficient. In others, such as Maryland, Connecticut, New Jersey and California, a real effort at enforcement is being made and both stationary roadside scales and traveling crews of inspectors with loadometers are employed to weigh at the roadside trucks suspected of exceeding the legal limit. The enforcement measures in Maryland, where loads in excess of the larger limit must be deposited at the road side and collected on a second trip by the truck were described at length in *Engineering News-Record* of April 21, p. 666.

Trucks loaded beyond their rated capacities are recognized by both highway engineers and motor-vehicle manufacturers as a menace to highway transport development. Some of the state laws strike at this objectionable practice. Referring again to the proceedings of the recent annual meeting of the National Highway Traffic Association, D. C. Fenner (of the International Motor Co., and chairman of the committee on truck regulation), condemns the overloaded truck and favors the enactment of laws providing for the weighing of vehicles and penalties for violation, including the removal of the excess load and the registration of the offending vehicle on the basis of the total gross weight of the vehicle at the time it was overloaded.

In some of the states where maximum gross weights are specified the state highway commissioner or other official, as is the case in Ohio, New Hampshire and elsewhere, is given authority to lower the weight limit during certain periods of the year when the frost is leaving the ground and the roads are soft. Without seasonal restrictions of this kind many miles of unsurfaced road would be rendered unfit for use in a comparatively short time if even a few trucks of great weight were allowed to operate over them during the spring thaw.

As a supplement to any discussion of gross-weight truck limits certain statistics are apropos. At the end of the year 1920 the U. S. Bureau of Public Roads reports a registration of 852,362 motor trucks and commercial vehicles. There were produced during 1920, according to the National Automobile Chamber of Commerce, 322,039 motor trucks, as shown in Table X. It is to be noted that the 1-ton truck is the prevalent size, constituting 51 per cent of the 1920 production; that the 5-ton truck constitutes only 2 per cent of the total output; and that trucks exceeding a capacity of 5 tons represent only 1 per cent. While the number of large-capacity trucks is comparatively small, costly damages to road surfaces can be done by only a few of these large units.

Extremely heavy trucks or those loaded beyond their rated capacities have been the main target of legislative revision in the states this year. In Ohio a bitter fight was waged over the Burke bill, limiting gross loads to 10 tons, which was signed by the governor in

TABLE X. PRODUCTION OF MOTOR TRUCKS IN 1920

Cap., Tons	Number	Per Cent of Total
¼	61,187	19
1	164,240	51
1½	35,424	11
2	25,763	8
2½	12,871	4
3½	12,893	4
5	6,441	2
Over 5	3,220	1
Total	322,039	100

spite of objections by the commercial trucking interests. Maryland refuses to register a truck exceeding 10 tons gross weight. In Wisconsin there is now under consideration a bill to designate types of roads which may be used by certain classes of traffic. On class A, or the highest type, the gross load limit would be 12 tons, on class B roads, 7 tons, and on class C roads, 3½ tons. The road classification would be made by the state highway commission, in the case of the state system routes, and by county or other local authorities in other cases. The Utah law specifically limits loadings to 400 lb. per inch width of tire on earth and gravel roads but allows 600 lb. per inch width of tire on hard surface highways.

In a few of the states which have gross-weight limitations for motor trucks, exceptions are made in the case of trucks which operate exclusively within city limits. In such cases the gross-weight limit is raised, on the ground that the comparatively heavy construction of city pavements is adequate to support loads greater than could be safely borne by rural routes. A great many of the laws, however, contain clauses which allow the transportation of a load exceeding the legal limit in certain special cases, where permits are required.

In addition to the license fees, a number of the states place a tax on gasoline. Among them are Colorado, Kentucky, New Mexico, North Carolina, Oregon, Washington, Louisiana and Pennsylvania. In California this year, an attempt to tax gasoline was made, but met with such bitter opposition that it was defeated.

Form of Law

Irrespective of the subject matter the form in which motor-vehicle regulations are issued to the public leaves much to be desired. A few of the states have prefaced the printed reproduction of the law with a condensed summary, showing at a glance the information the average motor-vehicle user should know about license fees, weight restrictions and speeds. As a general rule, however, the seeker for information must plod through page after page of legal phraseology in small type, unrelieved by subheads indicating the subject under discussion. It is common, too, to find numbers spelled out instead of the much more readable form of figures. Legislators, apparently, have not yet discovered that where a number of figures bear a relationship one to the other, they are much more understandable when presented in the form of a table than as text. In only a few of the laws is matter tabulated. A more general adoption of the tabulation, instead of the text, principle in motor-vehicle laws would simplify them tremendously.

Another serious objection to the booklets which most of the states issue is the lack of an index, although there are notable exceptions. Presumably these laws are issued in printed form in order that the public may become acquainted with them and thus avoid violations of the restrictions imposed. It would seem advisable, therefore, to include an index as part of the booklet. Without it the task of finding what the law prescribes on a given subject, such as weight of vehicle, is discouraging.

Enforcement of motor-vehicle laws has come to be recognized as of equal importance with their passage. This opinion is reflected in the recent legislation of certain states—Virginia, for example—where the powers of sheriff are delegated to the state highway engineer and certain other members of his staff.

Future Changes Probable

State legislation governing the taxation and licensing of motor vehicles will undoubtedly undergo many further changes during the next few years. A new phase of the situation is looming up in the form of a proposed federal, in addition to state, tax on motor vehicles. Highway engineers, motor-vehicle manufacturers and truck users are, today, in closer agreement on the essentials of motor-vehicle legislation than ever before. Several years ago it was common to hear the motor-truck manufacturer condemn the state highway official because roads were not designed and built to carry any loads that any vehicle operator might see fit to impose upon them. Without, apparently, realizing the inconsistency of his position, the same representative of the motor-truck industry was loud in his abuse of operators who overloaded the trucks supplied to them! Evidences of this narrow attitude on the part of both state highway and motor-vehicle interests are fast disappearing. At meetings of road-building organizations, of state highway officials, of motor-vehicle manufacturers, and at conferences on highway transport there is being shown a conception of the highway transport problem in its broad aspects and not from the point of view of a single selfish interest. It is true, of course, that all the differences between the highway builder and the highway user and vehicle manufacturer have not yet been composed, but progress is being made. The important thing, now, is for highway engineers and motor-vehicle representatives to work together to the end that future changes in state laws may be just and may lead to the best development of highway transport on economic lines.

Housing Contracts in Britain

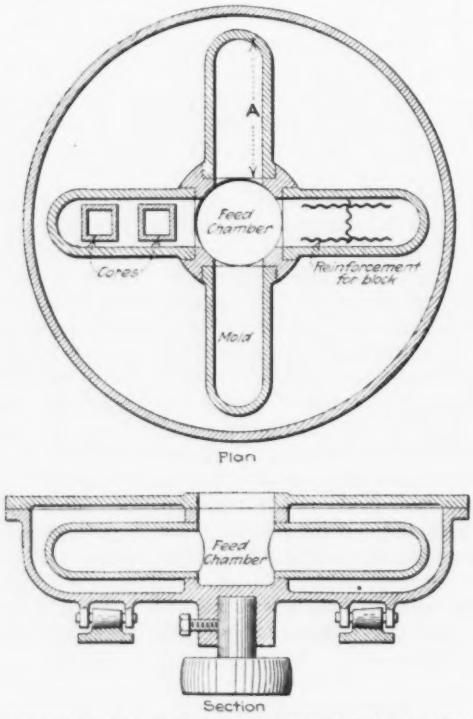
(London Correspondence)

The British Ministry of Health had, on May 1, approved tenders for 176,000 houses. Of these contracts had been signed for 150,000 houses and work begun on 102,000 houses. Four hundred and fifty thousand houses have been practically completed, including subsidised houses. In April 6,000 houses were completed, and, at the present rate of building, 7,000 houses will be completed during May. On April 1 130,000 men were employed on contracts with the Ministry. Sixty pounds a year is the estimated loss to the State on each house after allowing for the net rent and the local penny rate. With the number of houses to be erected between 200,000 and 300,000, the burden on the taxpayer will be between £12,000,000 and £18,000,000 while the housing scheme is in operation. The price of building is coming down, for in August, 1920, the average house cost £950 and in March, 1921, this average had been reduced to to £850.

Centrifugal Machine Casts Solid Concrete Shapes

By Leon Cammen
Cammen Laboratories, New York City

CENTRIFUGAL casting of solid concrete shapes has been successfully accomplished by a machine especially designed for this purpose, the first working model of which was recently sent to England for use on a government contract for houses for workmen in the North. The revolving portion of the machine carries forms or molds, of any shape desired, to which concrete if fed by centrifugal action through a central orifice. It is not considered that an excess of water in the concrete mixture can harm the product since the centrifugal action forcing the concrete into the molds will at the same time force out any excess of water. A sketch indicating the elements of the machine is shown herewith.



CENTRIFUGAL CASTING MACHINE FOR SOLID CONCRETE SHAPES

The sketch indicates the principal features of balanced rotating molds as developed for practical use. The machine has a vertical shaft and concrete is fed into the central chamber from which it is distributed by centrifugal force into the molds. The number of the molds may be determined by the size of the machine and the article cast.

In casting, an excess of water is not only permissible, but desirable, since it tends to make the concrete more plastic in the initial stages of spinning, and is then squeezed out by centrifugal force during the process, the amount of water present in the final product practically being governed by the speed of rotation.

Where the molds are quite large it has been found desirable to provide additional supports in the form of rollers running on tracks to relieve the shoulders of molds from stress. When the molds are small, they may be attached directly to the central structure comprising the feed chamber. With large or heavy molds it has been found advisable to inclose the rotating structure in a casing, as shown in the elevation.

The shape cast may carry reinforcement, as shown in the plan, properly placed in the mold, and about which concrete packs under centrifugal action. Hollow articles also may be cast on the machine by placing cores in the mold, as shown in the left arm in the plan. However, some care is required and if cores are not properly placed, there is a possibility that concrete will not pack solidly about them, and especially between them if there is more than one core.

The time necessary to fill a mold varies from 30 sec. to 90 sec. depending upon the shape and size of the mold, but it is advisable to continue spinning for about 60 sec. more to consolidate the material more closely. The mold is then opened and the cast shape discharged. Several methods of opening may be employed, depending on the shape and size of the article cast, and the presence or absence of cores. The simplest method is to have the mold open its full length from the bottom, permitting the shape to fall onto an endless belt.

When the shape is cast there is usually a finlike part projecting from the mold into the central feed chamber. If desired, a cutter may be provided, sliding up and down along the walls of the feed chamber, and trimming the shape before it is removed from the mold. The handling of the completed shape is very much facilitated by the solidly packed quality of the material which keeps its shape well.

All patent rights on centrifugal casting of solid objects and the machinery for doing it are controlled by the Cammen Laboratories, a research organization of New York City.

Weekly Map Service for Wisconsin Road Users

A BLUEPRINT map showing routes and road conditions has been published each week this season by the Wisconsin Highway Department. About 16 issues will be furnished for $10 to subscribers which are chambers of commerce, hotels and garages. Each of the nine division officers of the department also receives a copy. At the beginning of July there were 60 subscribers and it was expected that there would be fully 100 before the season for automobile tourists travel was over. Posted by the subscribers where road users can readily consult them, these maps have proved immensely popular.

The blueprint map is made from a tracing of the large Geological Survey map of the state and shows the state trunk highway system, the lakes, streams and places of interest, as well as the larger towns. It also shows the type of road on each part of the system, whether it is plain sand, sand-clay or loam, heavy clay, gravel, concrete or other surfacing. All construction jobs under way are indicated. If the job permits traffic to follow the present road, it is shown on the blueprint map as "Under Construction." If the conditions warrant a detour, it is shown as "Detour." The condition of the road under construction, or the detour, whichever the case may be, is shown as "Good," "Fair," or "Poor."

Division engineers mail to the main office Monday night of each week a statement of the new construction jobs under way and those that have been completed and

opened for traffic. The main office makes the changes on the tracing promptly upon receipt of the information from the division offices and the new blueprint maps, with up to date information are mailed out promptly Wednesday afternoon and get into the hands of the subscribers to the service some time on Thursday. The subscription price just about covers the cost of the blueprints. The information demanded from the division offices is nothing in addition to what they furnish regularly to the home office.

The Linear City in Theory and Practice

PAPER projects for cities long and narrow in plan, with open country on either side and generally with a central transportation system, have been given publicity at intervals for years past and one such plan has been carried out in considerable part. A similar plan, purporting to be new, is now being circulated by "Walker O. Nettleton, Originator," 1746 Euclid St., Washington, D. C., in the form of a white print showing a "City Layout According to the 'Backbone' Plan." This is further described as "A new and improved method of city building; a city limited in width and unlimited in length, having a business section running throughout its longitudinal center, flanked by residential sections."

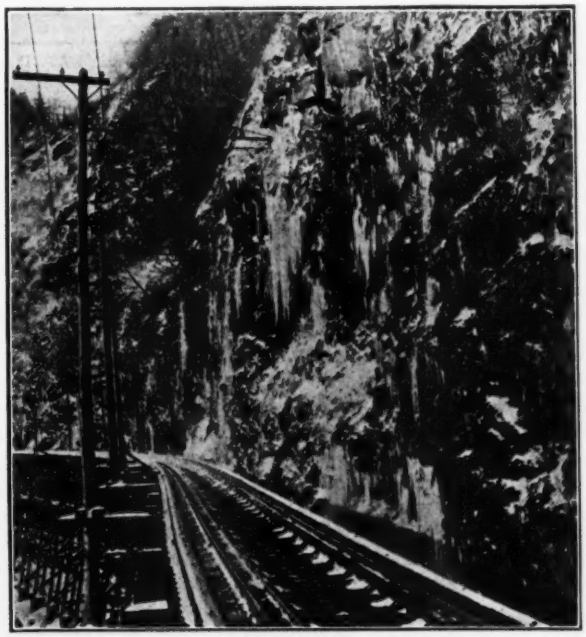
Almost simultaneously with the "Backbone plan" the mail brought the May *Journal* of the American Institute of Architects, containing an article on "The Spanish Linear City," by Edith Elmer Wood. Besides describing this city, which was begun some years ago not far from and concentrically with Madrid, Spain, Mrs. Wood reviews more or less similar plans, outlined from time to time, first in *El Progreso*, by Don Arturo Sorio y Mata in 1882-3 and on down to a prize-winning paper by Milo Hastings in the *Journal* of the American Institute of Architects for June, 1919, including "Edgar Chambless' continuous-house idea as set forth in Roadtown (1910)." Similar in principle as regards open country around relatively small urban areas are the garden cities, described by Ebenezer Howard (1898) in "Garden Cities of Tomorrow" and put into practical effect in England by a company incorporated in 1903. The linear city just outside of Madrid, described by Mrs. Wood in the article already named, has been built by the Compañia Madrilena de Urbanizacion, incorporated in 1894, with a capital stock of 2,500,000 pesetas ($500,000 at present exchange), since increased tenfold. Of a projected 50 kilometers in length, about 5.2 km. have been built and 8 km. more started. Besides building streets and houses, the company has provided trolleys, electric light and power, a savings bank, and makes its own brick and tile. The original one-street plan has been modified to give three longitudinal streets, with lot restrictions tending to permit smaller houses on the outer margins and make the lots larger as the central axis is approached.

In 1919, Señor del Castillo, author of a Spanish pamphlet designed to show the superiority of the Spanish linear to the English garden city ("Giudades Jardines y Biudades Lineales") and also of a pamphlet translated by Georges Benoit-Levy as La Cité Linéaire, both published in 1913, prepared for the Brussels Reconstruction Commission, a Project de Cité Linéaire Belge, which shows five longitudinal avenues, use zones, a civic center, and along either side a dairy farm and market garden area.

Build Long Tunnel to Eliminate Operating Hazard

Southern Pacific Company's Studies of Various Plans Show Net Annual Profit in That Adopted

CONSTRUCTION of a 1,400-ft. single-track tunnel through solid rock, at a cost of some $230,000, has been undertaken by the Southern Pacific Co. primarily to eliminate the operating hazard from falling rock encountered on the electrified suburban Newburg Branch, at Elk Rock, on the west side of the Willamette River, immediately southward of the city of Portland, Ore., where a trestle over 700 ft. long skirts the base of the cliff. Various plans, including detours, a fill in the river, a three-span bridge, heavy timber sheds, and excavating, wire-netting and guniting the cliff face, were thoroughly analyzed and all showed an increase not only in investment but also in operating cost. The



TRESTLE AT BASE OF CLIFF FOUND TO BE ENDANGERED BY FALLING ROCK

plan adopted, providing for a tunnel through the cliff now skirted by the trestle, was found not only to offer a complete solution of the operating hazard but also to represent a decrease in operating cost and an increase in net operating income, while increasing the investment some $175,000. Location of the old and new lines is indicated in the accompanying drawing and a portion of the cliff face adjacent to the trestle is shown in the photograph.

Following the opening of the line it was found that the tendency of the cliff to disintegrate was aggravated by vibration effects of passing trains. Several slides occurred, damaging passenger cars. On one occasion an electric car was badly damaged by a slide carrying a large rock which penetrated the roof, resulting in the injury of six persons. The extent to which the railroad company was prepared to go to eliminate this hazard is

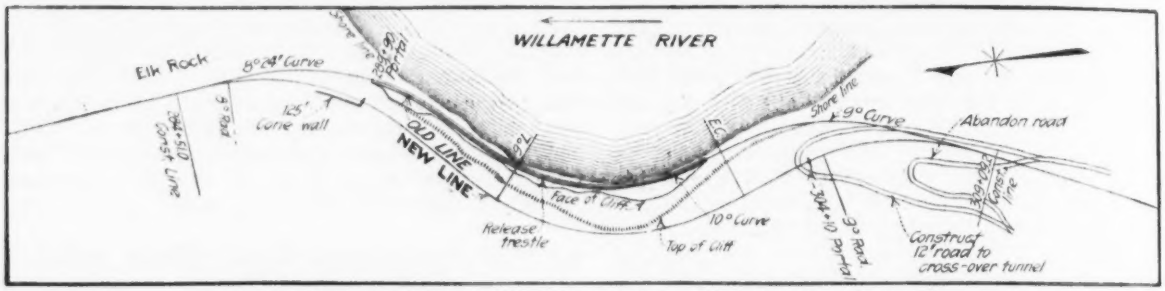
indicated by the radical measures and expense involved in plans which were considered and thoroughly analyzed.

Three of the plans considered involved abandoning the trestle line and rerouting traffic: One, providing for electrification and for operating changes in freight transfer, another for steam operation, and another for diversion of passenger traffic maintaining the trestle for freight service only. These plans were found to involve not only increases in investment from $500,000 to $800,000, but also adverse traffic influences and high maintenance that would be contributing factors towards decreasing net annual operating income in amounts ranging from $90,000 to $200,000.

Plans were also considered involving replacement of the trestle with a single-track line on embankment, located to provide minimum space of 20 ft. between track center and foot of bluff slope and not less than 50 ft. at points where bluff face is unstable, and replacement of trestle by constructing a bridge between the benches on Elk Rock, for which a structure of three 260-ft. spans would be the most economical. While the hazard from falling rocks would be minimized by the embankment plan, it was considered that it would be necessary to clean the bluff at least yearly but without hazard to traffic and at much less than previous expense. It was also thought probable that excessive maintenance cost would develop from placing the fill in the heavy river eddy. Practically the same advantages would accrue to the bridge plan but it would be directly across navigation downstream and might result in the necessity of providing a channel for navigation on the other side of the small island opposite. The embankment plan was found to involve an increase in investment of some $570,000 and a decrease in annual operating income of about $24,000. The bridge plan showed an increase in investment of about $510,000 and a decrease in net annual operating income of about $27,000.

Plans providing for two types of shed roof protection of heavy timber construction were rejected since only complete relief was considered satisfactory. It was proposed that the trestle might be protected with heavy snowshed type shelter with sloping timber roof anchored to the bluff, 550 ft. of which would be required, or by a modified and cheaper design with a flat roof carried on bents, each design sufficiently strong for protection against rocks of two tons falling 60 ft. The danger of fire hazard under partial steam operation was considered a serious disadvantage, as well as the fact that only partial protection would be afforded.

Plans were also considered involving the following measures: (1) Excavate face of bluff along portion where falling rocks menace the trestle, sloping the bluff to a uniform ¾ to 1 face; (2) cover the face of the bluff where falling rocks may cause damage or accident with wire mesh fastened to vertical cables anchored to the bluff; and (3) cover the face of the bluff with wire mesh (as in 2) and add ⅜-in. coat of cement or gunite. The first plan was rejected on the ground that it would afford complete protection only if the work exposed solid rather than disintegrating rock. It was also thought that too great a hazard would be involved from shooting the rock during construction. Plans 2 and 3 for covering the face of the cliff were rejected on the ground that they would be experimental and would only give relief that might be considered temporary. Both plans were found comparatively inexpensive and it was thought that they should remove the actual hazard, but each showed a net annual decrease in operating income of from $4,000 to $8,000.



LINE OVER TRESTLE DIVERTED BY CONSTRUCTING 1400-FT. TUNNEL.

The study developed that the plan adopted for constructing the tunnel to replace the trestle, as indicated in the accompanying drawing, would not only remove the operating hazard entirely but would also result in a net increase in operating income of more than $6,000, with an increase in investment of about $175,000, the total investment becoming about $300,000. The annual cost of maintaining the new treated timber bent trestle that would have to be built to replace the old one was estimated at $17,720, including $5,120 for scaling the bluff twice a year as heretofore necessary. The estimated annual maintenance cost for the tunnel line was $2,500, or $15,220 maintenance cost in favor of the tunnel line. With interest on increase of investment figured at 7 per cent the decrease in annual operating cost of the line was estimated at approximately $2,300, since the tunnel plan involved no changes in operation or transportation expense. With traffic influence and future development of territory served, net annual increase in operating income was estimated at upwards of $6,000.

The contract for the construction of the tunnel was recently let to the Hauser Construction Co. of Portland whose bid was $228,000.

Thirty-Three States Engaged in Forestry

Thirty-three states have provided for some kind of forestry work and 25 of these share in the Federal co-operative fund alloted to the states for fire detection and suppression, according to a circular issued by the United States Department of Agriculture. Pennsylvania, under the direction of Gifford Pinchot, the new commissioner of forestry, leads the states in forest activities, says the circular. Its latest biennial appropriation for forestry work totalled $1,870,000, of which $1,000,000 is for forest fire protection.

German Sewage Settling Tanks with Separate Sludge Digestion

By M. B. Tark
Engineer, Link-Belt Co., Philadelphia, Pa.

GERMANY built many sewage-works during the war but most of them were for military or semi-military purposes. Some of the plants mentioned in this article were completed or under construction when the war broke out. As usual the principal efforts of the German engineers were directed toward the improvement of the sedimentation tank. This was mainly due to the trouble given by plants in which the sludge digesting chamber is located under the sedimentation chamber and connected to it by a slot, such as the Imhoff, Travis and many other tanks. After the severe criticism of

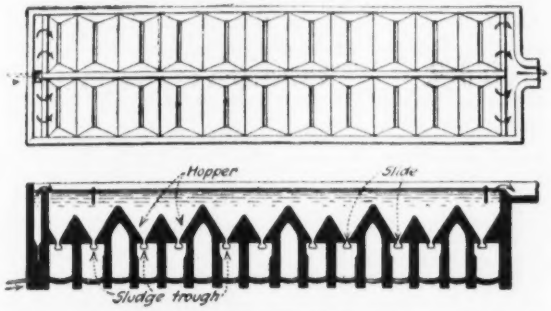


FIG. 1. KOETHEN TANK DESIGNED BY DR. DUNBAR

these tanks Prof. Dr. K. Thumm and Prof. Dr. E. C. Reichle, division superintendents of the National Institute for Water Hygiene, a condensed translation of which appeared in *Engineering News*, Dec. 31, 1914, p. 1306, most designers turned to the sedimentation tank with the separate sludge digesting chamber. Many such plants have been built and some have given splendid results. One of the older and most unique plants is the Koethen tank, Fig. 1, designed by Prof. Dr. Dunbar and described by him in detail in the *Gesundheits Ingenieur*, 1918, No. 30 to 32. His claim—based on the results obtained by the operation of this tank for several years—that a sludge digesting tank is entirely unnecessary, and that the sludge from sedimentation tanks can be dried in from two to four days, if treated according to his directions, has been bitterly attacked by most of the leading engineers in

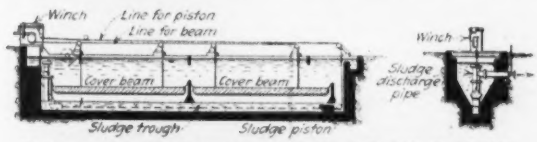


FIG. 2. NEUSTADT TANK, WITH BEAMS, PISTONS AND TROUGHS

Germany. They pointed out that the sewage of Koethen could not be compared with normal city sewage; that 80 per cent of all the sewage has been treated in small domestic plants, before being discharged into the sewers, and that the good results obtained in clarification and drying of the sludge are due to this factor.

The Koethen tank, having a capacity of 0.8 m.g.d., is about 98 ft. long and 26 ft. wide. A partition wall runs the entire length of it and the bottom is divided into 22 hoppers, ending in troughs. Each trough is

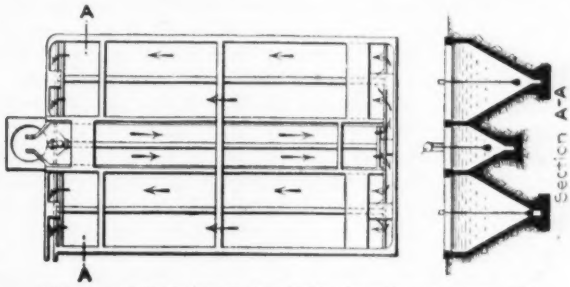


FIG. 3. NEUSTADT TANK FOR INDUSTRIAL PLANT

provided with a slide about 8½ ft. long, by means of which it can be shut off from the supernatant sewage, and a gate at one end which gives access to the trough. The settled sludge is withdrawn in the following manner: The long slide at the top of the trough is closed and the gate at the end opened. The sludge is removed and the trough washed out. The gate is then closed, the trough filled with sewage and the slide withdrawn. The sludge is left to settle in a common sludge trough for 6 hr. and is then run on the sludge beds, where it becomes spadable in from two to four days. As every one of the 22 troughs has to be emptied once daily and those nearest to the influent end twice daily, the good results obtained by this tank will be more than counterbalanced by the difficulty of operation.

In the Neustadt tank, Fig. 2, the withdrawal of the sludge is a great deal simpler and quicker. This—like the Koethen tank—is a horizontal-flow tank and

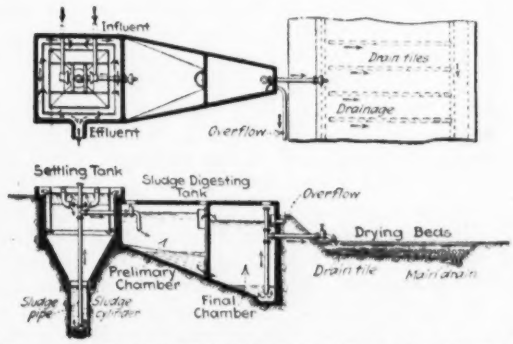


FIG. 4. PLAN AND SECTION OF KREMER-KUSCH TANK

has only one sludge trough, running the entire length of the tank. To withdraw the sludge, one or more beams are lowered onto the top of the trough, the valve at the influent end is opened and the sludge piston moved through the trough, pushing the sludge ahead of it. This sludge piston is operated by the hydraulic head—the sludge discharge pipe is about 3 ft. below the water level in the tank—and returned to its position at the effluent end by a hand winch. The experimental tank at the City of Stuttgart is about 56 ft. long by 6 ft. wide and 7 ft. deep; the detention period 3 hr., the sludge trough 12 in. wide and from 12 to 20 in. deep. This design has been used for several industrial plants (Fig. 3) and apparently has given fair results, although at the experimental plant at Stuttgart the sludge piston has given trouble.

In the Kremer-Kusch tank, Fig. 4, all moving parts have been eliminated. This is the old Kremer tank, always noted for its efficiency, with the addition of the

Kusch sludge cylinder and the Kusch digesting tank. The sedimentation chamber is from 15 to 20 ft. square and has a hopper bottom, terminating in a cylinder about 4½ ft. in diameter and 8 ft. long. The inlet is submerged. It is claimed for this design that through the careful arrangement of the baffles and the long overflow weir every part of the sedimentation chamber is utilized to its fullest extent, and that in several municipal installations 95 to 98 per cent of all settable solids were removed. In the experimental plant at Stuttgart, an Imhoff, a Neustadt and a Kremer tank, each having a 3-hr. detention period, were installed. The test lasted for about a year. The efficiency of the Kremer tank was 12 per cent higher than the Imhoff and 16 per cent higher than the Neustadt tank. As in the Kremer-Kusch tank, the contact area between the sludge in the cylinder and the supernatant sewage is very small. The sludge has to be removed only every third or fourth day. This period of detention at considerable depth reduces the moisture content of the sludge to about 88 per cent and in some places an average as low as 82 per cent has been obtained (Hildesheim). To withdraw the sludge a valve is opened and the hydraulic head forces it up the discharge pipe and into the sludge digesting tank. The present form of the latter has been envolved after years of study and experiment. The digesting tank is usually the same width as the sedimentation tank and up to 55 ft. long. As there are two distinct stages in the process of digestion, the tank is divided into at least two chambers. In the large shallow preliminary digesting chamber the fermenting sludge has ample space to come to the surface, to spread there and get rid of the rapidly developing gases. In the smaller and deeper final digesting chamber the sludge in the quieter stages of digestion retains enough gases to give it the porosity necessary for quick drying.

Such tanks have been installed in a dozen cities and have given uniformly good results, both in the removal of suspended solids and in the thorough digestion of the sludge. The largest of these plants is in the City of Hildesheim and takes care of the sewage of 60,000 inhabitants. After passing through a grit chamber and bar screen the sewage is settled in ten Kremer-Kusch tanks, each 16 ft. square and figured for a 2-hr. detention period. The digesting chambers have a capacity of 23,300 cu.ft. of sludge and of about 2⅝ ft. of supernatant water. The drying beds have an area of 25,800 sq.ft. The sludge is discharged into a common sludge well and pumped to the digesting tanks arranged in a circle. The two sprinkling filters shown in the background treat one-quarter of the flow.

The sedimentation plant for the City of Rottweil was built in 1917. The sewage of a population of 12,000 is treated in two tanks each 18 ft. square. The detention period is 2 hr., the effective capacity of the sludge digesting chambers is 10,594 cu.ft., and the drying beds have an area of 2,700 square feet.

I understand that the installation of a Kremer-Kusch plant near Philadelphia is contemplated in the near future. The results obtained will be looked forward to with the greatest interest. If these digesting tanks should be able to digest activated as well as ordinary tank sludge, they will help to solve the vexed problem of sludge disposal for these plants, especially for the smaller sizes, where the pressing and drying of the sludge is out of the question.

Felling Two Brick Chimneys by Dynamiting at Base

Stacks Were Thrown Toward Each Other—Both Broke in Two Places—Top Landed Vertically on Middle Section

By H. B. Hommon
Associate Sanitary Engineer, Public Health Service, Cincinnati

TWO brick chimneys in restricted quarters were recently removed from the site of an abandoned city water-works pumping station in Cincinnati by dynamite. The stacks were 165 ft. high and located about 90 ft. apart on property sold by the water department 13 years ago. They were about 200 ft. from the Ohio River to the south; the east chimney was within 175 ft. of an abandoned brick building. Railroad yards and freight sheds lay 75 ft. to the west and 300 or 350 ft. to the north of one or the other of the two chimneys. About 20 ft. beyond the chimneys and between them and the river was a deep pit of sufficient size to hold all the bricks in the stacks, but as it was desired to recover the whole brick, the chimneys could not be thrown in this direction.

WEST STACK BROKE IN TWO PLACES; FELL DIRECTLY TOWARD EAST STACK

On account of the nearness of the building to the east and the railroad property at the north and west, the only available space on which the stack could be thrown was that lying east and west between the chimneys. There was some leeway to the north but to the south the open pit was within 20 ft. The contractor, J. S. Glassmeyer, of Cincinnati, decided to remove the west stack first and attempted to throw it against the east stack with the hope of knocking the latter down.

At the base of each chimney there was a rectangular section 12 ft. square and 12 ft. high. Four holes were drilled 2 ft. into the 30-in. walls of the base of the first chimney thrown. Two of the holes were 2 ft. from the corners of the wall facing the east chimney, one was placed in the south wall 2 ft. from the southeast corner and one in the north wall 2 ft. back from the northeast corner. Five ½-lb. sticks of 60-per cent dynamite were placed in each hole, packed with moist clay and discharged by a battery removed from the contractors's automobile.

When the dynamite was exploded a large enough section of the base was blown out to cause the chimney to fall in a bee-line with the east chimney. The stack remained intact until it reached an angle of about 45 deg., when it broke in two places. The middle section fell with the lower part while the upper section dropped vertically on top of the middle portion. The section that remained practically intact hit the east chimney near the base but did no more damage than to shake a few

bricks off the top. A circular section 8 ft. high immediately above the rectangular part of the foundation rolled to one side and did not break.

Holes were drilled in the east chimney to throw it directly on top of the one already down. These holes, however, were drilled in the round section in a half circle that cut through the flue opening. Seven of the nine holes were drilled to the south (right) of the flue opening and two to the north. Eight of the nine holes were west of the north and south diameter, the other hole being just east of the south end of the median line. The holes were drilled 2 ft. into the 30-in. shell. Two 1-lb. sticks of 60-per cent dynamite were packed in each hole with moist clay and they were exploded by a battery. This chimney fell just as the first one did. When it reached an angle of 45 deg. the upper quarter section parted from the rest and fell on top of the middle part of the chimney which reached the ground first. The rectangular section below the place where the dynamite was exploded remained intact.

Both chimneys fell almost in the identical space desired, and outside of drilling the holes the entire time in telling them was not over two hours. Moving pictures were taken of both chimneys while they were falling and the films show every detail of what happened. Engineers or societies interested can obtain the use of the films from the contractor at a slight cost.

Precast Blocks Used Alternately with Concrete in Dam Coping

Method Less Costly Than Continuous Blocks—Odd Section Gives High Discharge Coefficient—Coping Set Without Dowel Pins

By David C. Finston
Philadelphia, Pennsylvania

In placing the spillway coping for the new concrete dam recently built by the Springfield Water Co. near Media, Pa., a method was devised whereby precast blocks 3 ft. long were set on 6-ft. centers and the intervening spaces filled with concrete. The blocks could then be placed to grade easily. The dam, which was finished in the early part of 1920, is a cyclopean concrete dam with a rough stone masonry face.

The spillway coping which along with the dam was designed by J. W. Ledoux, consulting engineer, Philadelphia, was to be built, quoting from the specifications "of Class A concrete and constructed of precast blocks in lengths of not less than 3 ft. or poured in place in alternate blocks of not less than 5 ft. The exposed surface shall be finished smooth and hard and true to line. Great care shall be taken in placing the blocks that the crest shall be level and exact. If precast

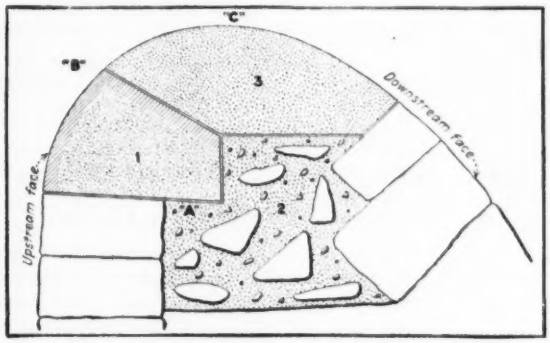


FIG. 1. CROSS-SECTION OF SPILLWAY COPING

blocks are used the mortar bed shall be the same as for the facing stone." From these alternate methods, the contractor chose at first to make precast blocks. However, after about half the blocks were formed he concluded that the cost was prohibitive and therefore he was allowed to place the stone, leaving alternate spaces which were then filled with concrete and which resulted in excellent work.

The dam was built up in 33-ft. lifts as follows: The masonry facing was first built up with large stones handled by derricks and the space between was then filled in with concrete and boulders. When the concrete was set the next 3-ft. lift of masonry facing walls was constructed. When the top course of masonry facing was completed, the back facing of the coping designated 1 (See Fig. 1) was placed in position. This section was all laid up of concrete blocks. A part of each block was allowed to overhang the stone masonry at *A*.

With the first course of coping blocks in place, the concrete forming the core could be poured. This was done and special care was taken to spade the concrete well under the coping block so that there would be no holes. The top of this concrete was leveled off within ½ in. of the top coping blocks to allow for the mortar and the adjustment of the blocks to the proper elevation.

Only the outer edges of the joints were cemented, and after the concrete was placed a cement grout was poured through the opening at *B*. When the grout was poured it not only filled the joints but also any possible space that might have been left beneath the overhang of the first course of the coping blocks.

The next operation—placing the top coping blocks—was done with extreme care. It was in this operation where a great advantage was gained in placing the blocks alternately. One mason on either side could raise or lower the block and move it into place, the proper elevation being secured by taking level readings at either end of the block at the crest.

The final operation was to fill in with concrete the spaces between the blocks. Proper spading and other measures assured a good bond between all coping blocks. It was a simple matter to finish off the poured blocks to the same elevation and line as those previously set

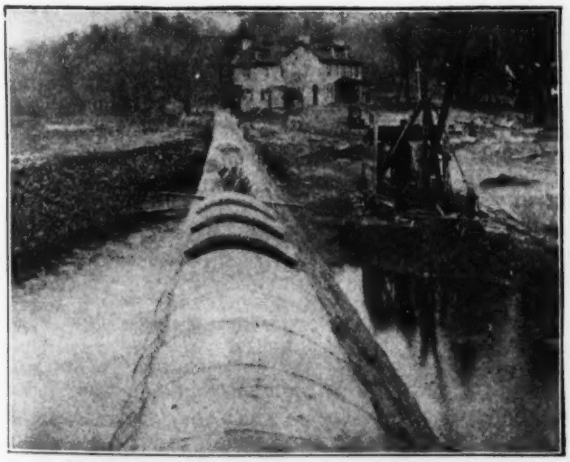


FIG. 2. TOP COURSE OF PRECAST CONCRETE BLOCKS SET ALTERNATELY

and the net result was a uniform coping of pleasing appearance.

In the Crum Creek Dam, where the spillway is 210 ft. long out of a total length of 500 ft., the engineer designed an ogee section of concrete as shown in the accompanying sketch. The unique feature of this coping is its shape, which allows a high coefficient of discharge, and the fact that there are no dowel pins used.

The building of the dam was performed during the war on a strictly contract basis and within the estimated cost. The contractor was Andrew O'Neill of Philadelphia. S. H. Wright, hydraulic engineer with J. W. Ledoux, was directly responsible for the engineering supervision of the construction of the dam.

Experts Deny Bomb Caused Collapse of Boston Molasses Tank

Nearly three years have passed since the disastrous bursting of a large molasses-storage tank in Boston on Jan. 15, 1919, but damage suits depending on the cause of the failure are still undecided. Expert testimony in favor of the owners was summarized in ENGINEERING NEWS-RECORD *of Oct. 7, 1920, p. 691. Now the plaintiffs have presented expert witnesses in rebuttal. These find that the collapse was due to the great overstress of the tank shell; they deny that a bomb explosion was responsible for the failure, as had been claimed by the experts for the defence. Our technical correspondent has prepared a digest of the testimony for the plaintiffs, given below.*—EDITOR.

THE plaintiffs claim that the failure of the tank was due to weakness, and that the head of 48 ft. 9 in. molasses exceeded its capacity. Evidence shows that the tank was 90 ft. in diameter and that the shell was composed of seven rings each approximately 7 ft. high. The nominal thickness of the rings varied from $\frac{1}{2}$ in. at the bottom to $\frac{7}{16}$ in. at the top. The vertical joints in the lowest ring were spliced with double butt-straps, those in the rings above the lowest by lap joints. In the lowest ring there was a manhole 21 in. in diameter, provided with a flanged collar of $\frac{3}{8}$-in. plate and closed with a $\frac{1}{2}$-in. plate attached to the collar by means of an angle ring.

There were two principal fractures through the lowest ring, one being on a vertical line through the manhole and extending up into the second ring, part of the way in a lap joint which was located directly over the manhole. The other was a diagonal break through solid metal, the top of which was near the lap joint in the second ring next to the one over the manhole. The section of the lowest ring between these two principal fractures, together with a portion of the $\frac{3}{8}$-in. plates forming the bottom of the tank, was found at a distance of about 180 ft. from its original position. The plate of the second ring immediately over this fragment was also carried to some distance from the tank in a direction some 45 deg. away from that in which the lowest piece traveled. It was separated from rings 1 and 3 by tearing the single-riveted lap joints which connected them, and at the end farthest from the manhole by a vertical fracture through the outer line of rivets in the lap joint.

It is conceded by both parties that the initial break occurred in the vicinity of these two breaks in the two lowest rings. The defendant claims that an internal explosion must have thrown the fragments out, while the plaintiff claims that the rush of molasses, after the break occurred, was sufficient to have carried the pieces to the point where they were found.

SECONDARY STRESSES IMPORTANT

There is no great divergence in the testimony as to the average primary stresses in the ring plates under the static head of molasses, but much divergence as to the secondary stresses caused by the lap joints in the second ring, the effect of the 21-in. hole in ring 1, and the reinforcement that plate received from the collar. The defendant claims that the secondary stresses were "negligible," while the plaintiff claims that they were well above the elastic limit of steel.

It is conceded that the material was open-hearth steel of about 56,000 lb. ultimate strength and in general corresponding (though not uniform) yield point, elongation, and reduction of area. Much stress has been laid by the defendant upon the character of fractures found in the wreck, which were generally "short and sharp." The defendant at the outset claimed that such fractures could only be caused by a very suddenly applied force; but the plaintiff has produced samples of the tank plates, broken in a testing machine, showing the same "short, sharp" fractures. The defendant showed that Neumann bands were found near the edges of the fractures in the lower rings, and claimed that these were indicative of an explosion. The plaintiff claims that the violence of the wreck under pressure of the molasses was sufficient to account for the presence of these bands.

E. E. Pettee, consulting engineer, testified as to stresses which he computed as above the elastic limit of the metal in the manhole plate and in the lap joints of the second ring. He described the deformation in the bottom plate at the point where the defendant claimed that the bomb was placed, as a fold which was produced by the tearing away of the adjoining portion of the plate. He testified that all the rivet holes in the tank were punched full size. He believed that, with varying stresses above the elastic limit and with punched rivet-holes, the fracture was caused by the weight of the molasses, and that the dynamic force of the liquid, when released, would account for all effects noted after the accident.

C. G. Lutts, in charge of the metallurgical laboratory at the Charlestown Navy Yard, testified that the appearances of the metal after the wreck, including the presence of Neumann bands, were consistent with the theory of a break due to the molasses pressure. He produced tests showing Neumann bands caused by what he considered similar conditions, and also a plate from the tank broken in a testing machine after notching by means of a saw cut, which showed the short, sharp fracture with the so-called "herring-bone lines," or ridges characteristic of the tank breaks. He also introduced tests to show that fractures caused by explosions may show great ductility.

TANK WAS NOT STRONG ENOUGH

Prof. C. E. Fuller of the Massachusets Institute of Technology gave as his opinion that the tank failed from structural weakness which led to a condition where it was not strong enough to resist the stresses produced by its load of molasses. He was inclined to think the initial break occurred in the line of rivets

in the lap joint of the second ring, where secondary stresses from bending, and the hardening effect of punching, were liable to start incipient cracks. He believed that the Neumann bands did not support the explosion theory. He found stresses well above the elastic limit at the edges of the manhole as well as at the lapped joints, and saw nothing in the effects of the wreck inconsistent with his theory of failure. He attributed the fact that the tank did not fail the first time it was filled to the probability that the hardening of the metal had not developed sufficiently at that time.

Variations in Stresses Shown

Prof. Fuller introduced the results of numerous experiments which he had performed both with steel from the tank and with other similar metal to substantiate his views, including tensile tests of ordinary samples and of riveted and bolted joints, with extensometer measurements and templets showing deformation. He produced the results of extensometer measurements at different points on plates having holes in them of similar proportions to the manhole plate of the tank, which showed great variations in the stresses on the net section between the edge of the plate and the edge of the hole, and that the variation between these stresses was greater in a wide than in a narrow plate. He also showed, by Brinell tests for hardness, the effects of punching holes for rivets. He presented several sections cut through lines of rivets to prove the condition of rivet holes in the tank. He testified that the so-called "dent" in the bottom of the tank could not have been formed when the plate was in position because it was deeper than the layer of sand and cement which separated the steel from the concrete, and the concrete was not broken or dented.

Prof. R. S. Williams of the Massachusetts Institute of Technology testified, as to Neumann bands, that the violence of the accident was in his opinion sufficient to account for their presence without the assumption of an explosion.

Lapped Joints Were Weak

H. E. Morton, an expert on steam boilers, attributed the accident to the weakness of the lap joints in the second ring and the incipient cracks caused by punching. He made careful examinations of the surroundings immediately after the accident and remarked upon the absence of broken glass and other effects of an explosion. He introduced a cast of a section of the concrete rim of the supporting slab, taken from the part of the circumference under the fragment which was propelled out 180 ft. from the tank, which indicated by grooves made by the rivet heads that instead of moving out in a radial direction the first motion must have been at an angle of about 45 degrees from the radius.

J. R. Worcester, consulting engineer, testified that in his opinion the pressure in the molasses would have overstrained the lap joints enough to have caused a slight stretch which would have transferred a share of the stress naturally coming upon them to the solid metal of the adjacent rings. The effect of this as he figured it would have been to stress most of the rings above the elastic limit, and to make the extreme-fiber stress at the top of ring 1, under the lap joints, between 45,000 and 50,000 lb. per sq.in. This he believed was enough to account for the failure, when taken in connection with a punchtd hole in ⅞-in. plate. He testified that an explosive, sufficient to cause the accident placed where claimed on the bottom of the tank, would have blown through the bottom.

Speed of Fracture

He introduced calculations to show that the current of molasses would have easily washed the detached fragments to the distance they reached, and he attempted to compute the speed of fracture of the tank, by the recoil of the elastic stretch of the shell. He estimated the tear to have extended at a rate of over 600 ft. per second. This suddenness, he believed, would have accounted for Neumann bands. He claimed that the so-called "dent" in the bottom plate was caused after the section of the bottom plate had swung out from its original position and was resting partly on the ground and partly on the rim of concrete. By photographs taken immediately after the accident he showed the plate in this position with the molasses flowing over it.

Prof. Charles M. Spofford, of the Massachusetts Institute of Technology and a consulting engineer, testified as to secondary stresses in the tank and expressed the opinion that the tank was stressed above the elastic limit in many places. He confirmed the views of the other experts as to the deficiency of strength, and the consistency of all results with the theory that simple overload caused the failure. He attached no important significance to the presence of Neumann bands. He emphasized the entire absence of any reasonable factor of safety, such as would be required by good engineering and by common standards of practice in the erection of steel structures. He expressed the opinion that at the time of the failure the tank was in such a precarious condition that it was likely to give way at any time with or without some slight additional stress.

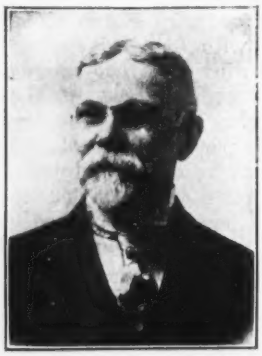
Secondary School of Irrigation Established

A SECONDARY school of irrigation with a two-year course and eighth-grade entrance requirement has been established by the University of Nebraska. The course is designed for men who wish practical and theoretical training in the measurement of water, simple surveying and leveling, minor construction and maintenance of ditches, methods of applying water, grading of land and the study and use of instruments employed in these operations. The course includes something of the administrative and legal principles pertaining to irrigation. The training offered qualifies men for the better performance of irrigation construction work, canal superintendence, operation of systems, ditch riding and similar occupations. It is the purpose of the school to increase the earning power of young men in irrigation work by better fitting them to solve many of the problems of irrigation on their own farms, by qualifying them for positions requiring trained employees, and to familiarize them with the best practices underlying irrigation farming. The instruction and training in the several lines mentioned above are of secondary grade. While the work given at the school has to do with the engineering aspects of irrigation rather than the agricultural, it is not the purpose to offer collegiate courses in irrigation engineering.

Searles—the Author of the Handbook

SOME months ago there died in Elyria, Ohio, a man whose name has been familiar to successive generations of college students and field engineers for forty years but who, in the person, was known to but few of the profession. William Henry Searles, as the author of the small black book all engineers know, has been a somewhat mythical personage. In fact he was an active railway locating and constructing engineer for many years but had long since retired from the active scene. In 1880 the first edition of his "Field Engineering" appeared and Mr. Searles, then a man of 43, took up his residence in Elyria and devoted himself to his books and to a desultory consulting practice. There he lived for 41 years.

Mr. Searles was born at Cincinnati in June, 1837, and was a student in Wesleyan University in 1856-7. He graduated in civil engineering from Rensselaer Polytechnic Institute in 1860, where he served as professor of geodesy and topography from 1862-64, after two years as assistant engineer on the Marietta and Cincinnati R.R. and engineer upon defenses of Cincinnati on the staff of General Mitchell. From 1864 to 1865 he was engaged in railroad construction and location in Ohio, Michigan, Pennsylvania, Indiana and New York. In 1865 he served as chief engineer of the Mineral Range R.R., Michigan, and subsequently as assistant engineer Allegheny Bridge, Pittsburgh, Fort Wayne & Cincinnati Ry. and as principal assistant engineer, Allegheny Valley R.R. The records show that during 1868 and 1869 he was a "manufacturer of petroleum oils, Cleveland, Ohio." In 1870 he became chief engineer of the Indiana North & South Ry. with headquarters at Indianapolis and in 1872 was appointed chief engineer of the New York, W. S. & C. R.R. Afterward he was engaged in New York State canal work as consulting engineer. After the publication of his book "Field Engineering" in 1880, he devoted himself entirely to private practice, though following his first work he wrote the "Railroad Spiral." "Field Engineering" in later years was revised by Mr. Searles and Howard C. Ives, professor of railroad engineering, Worcester Polytechnic Institute. Prof. Ives writes of Mr. Searles as follows:



WILLIAM HENRY SEARLES

It was not my good fortune to have met Professor Searles personally. All the work on the 1915 and 1919 revisions of "Field Engineering" was done through correspondence. Mr. Searles, although advanced in years, took an active part in both revisions.

Mr. Searles was most accurate and painstaking to the minutest detail. The originality, completeness and accuracy of the work enabled "Field Engineering" to hold its place for 35 years without a revision. Each printing in the olden days was called an edition, but no changes were made through a total issue of 50,000 copies.

A born teacher, every letter to me contained helpful suggestions. He counted on one grasping his points without undue discussion. I keenly feel the loss of his wide experience and realize the obligation in endeavoring to keep up his masterpiece.

The following excerpt from a letter gives some light on the inception of "Field Engineering" and its revision. "When 'Field Engineering' was first written I had informed myself as fully as possible on the theory and practice then prevailing, but I catered to no one and gave only what accorded with my own experience and best judgment. One chief function of the book is to educate the rising generation in the best way, and they will create a demand for the book, not only today, but in years to come."

Mr. Searles held his mental vigor to the end as evidenced by the following: "Perfection is a very coy maiden and it takes much patience and devotion to win her." This was taken from a letter written me six weeks before his death, and followed my report to him stating I had finished proof reading 230 pages of the original tables.

Water-Supply Cross-Connection Rules of Ontario Board of Health

CROSS-CONNECTIONS between municipal and auxiliary water supplies, with the exceptions noted below, are prohibited by an order in council recently issued by the provincial government of Ontario and published in the *Ontario Gazette* (Ontario, Can.). This order makes effective rules and regulations adopted by the Ontario Board of Health and approved by the Minister of Labor.

The order provides that private pipe systems for domestic and manufacturing service must be entirely independent of private pipe systems for fire protection, but that this shall not prevent service connections between "municipal mains and check valves," as covered in Section 4 of the regulations, as follows:

4. A connection may be maintained between a fire protection system, and a municipal water supply, and every such connection shall be protected with dual check valves of approved type, with the proviso that this section applies only to:

(a) Where overhead tanks are used as an auxiliary source for the supply of water for a sprinkler risk fire protection system.

(b) Where storage tanks are used solely for the supply of water for fire protection purposes, provided that on the discharge side of any pump used in connection with such storage tank, and for fire protection there is placed a gate valve, which shall, except in the case of a fire, be closed and sealed with light wire, and between the said pump and sealed valve a connection with a gate valve arranged to discharge to waste for testing purposes.

Where double check valves are required they must be installed within six months of the date of the publication of the order in council. Such valves must be similar to the Factory Mutual; must be approved by the Ontario Board of Health; must be arranged for testing as to water tightness, and must be subject to inspection and properly maintained.

A connection may be maintained between a private and municipal system, where the Ontario Board of Health "upon examination certifies" that the private "source of supply is of satisfactory quality, or satisfactorily protected for domestic consumption."

The order prohibits the connection of any system which circulates water for cooling or other industrial purposes with any fire protection storage tank. Another prohibition is any connection, except for fire protection, "between any auxiliary railway or factory supply, or any storage tank, and a municipal system; but the supply of water for the private purposes just indicated may be obtained through an open discharge to a tank "located above the highest water level."

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

American and European Bridge Practice

Sir—I have read with great interest P. H. Chen's article on "Railway Bridge Construction and Service by American and European Standards" in your issue of July 14, p. 58.

It cannot be said that bridges are designed for a particular type of locomotive, American or European. It is the load effect that governs. American locomotives have undergone many changes in the various types, Atlantic, Pacific, Mikado, Consolidated, Santa Fe and others, with a constantly growing increase in weight. We have been using a standard loading, the Cooper series, which is not a counterpart of actual locomotives but which has given practically equivalent results. It may be said without fear of contradiction that a railroad bridge designed for Cooper's E50 loading, with impact provisions, unit stresses, details of design, material, workmanship, etc., as called for in the last American Railway Engineering Association specifications, will be safe for any locomotive or train load that can be run over it for many years to come.

Committee XV, Iron and Steel Structures, A. R. E. A., has given much attention to the matter of railroad bridges, and the present issue of the specifications represents the best American practice and is applicable universally to the entire world.

There is very little difference in the quality of open-hearth steel used in America and in foreign countries. In America it is generally made by the basic process, while much of the foreign steel is made by the acid process. They both have an elastic limit of about 33,000 lb., with an ultimate of from 55,000 to 65,000 lb., and will bend flat on a radius equal to the thickness of the piece tested. In America we have attempted to get away from slight variations in specifications and get a standard steel, which has tended to bring about a uniform grade of consistent characteristics.

Mr. Chen is not correct in his statement that pony-truss spans are considered unreliable in American railroad practice. It is true that on nearly all heavy-traffic lines the early pony trusses have been taken out. These old trusses had single-web chords, poor floor-beam connections, and weak top-chord bracing. The modern pony truss, double-webbed, properly braced, is a good structure and is freely used where it will show the proper economy. It has to combat, in shorter lengths, the plate girder with its lesser shop cost, and in the longer lengths the through span with its reduced chord sections. In my own practice I have found several places where the pony truss span was the most practicably economical, and have used it in such cases.

The two examples of 150-ft. through spans given for comparison by Mr. Chen tell their own story. In the European span there is a distance of 21 ft. 4 in. out to out of chords, while the American span has a depth of 31 ft. 5 in. center to center of chords. With a standard clearance diagram of 22 ft. 6 in. vertical height above base of rail, which is followed in America for considerations of safety, the reason of the greater depth of the American span is self-evident.

Mr. Chen further says that the European span seems weak and lacking in rigidity. It certainly does. We cannot tell from a line diagram if the American span is too heavily braced. The matter of bracing needed to resist figured stress, and "adventitious" bracing, is one that calls on all the skill and previous experience of the designer. Sometimes the introduction of proper bracing is all that is necessary to allow increased loading to run over a span at fair speed. I have had several cases where such additional bracing constituted the only reinforcement used, after which the bridges gave good service for many years. Too little bracing may render a span absolutely unsafe. On the other hand, an excess, or bracing improperly applied, will be wasteful extravagance and may introduce some bad secondary stresses. Our ideas on bracing have been developed and modified by the observation of spans under traffic, and I believe that the general practice of American designers is now along proper lines.

Mr. Chen makes the broad general statement that American locomotives cause greater impact and vibration on bridges than European locomotives of the same approximate weight. The American locomotives, No. 411 and 272, shown on Mr. Chen's diagram, have weights which should cause greater effect on the bridges than the German locomotive, No. 153. A computation for static deflections would show higher results. It would also appear that the American locomotive should have greater tractive power. The figures for vertical deflection given in the table appear consistent. The figures given for lateral vibration, as corrected in a later issue, show 1.5 mm. for the German locomotive and 4.8 mm. and 7.0 mm. for the American locomotives. If these figures, admittedly roughly taken, are even approximately correct, it would seem to indicate that the American locomotives had been in much harder service than the German locomotive, and that they were long overdue at the shops for overhauling and tightening.

A severe indictment of the American locomotive is made in the statement that on the Pekin-Hankow line two severe bridge accidents resulted from the use of American locomotives that were actually lighter than the French locomotives in regular service on the line.

I have personally examined bridges for many years, extending over 15,000 mi. of track, to determine the necessity of repairs and renewals, not only with regard to the motive power regularly run over them, but also for the imposition of heavier power. I have many times found weak details in old spans, in hangers, truss details and in floorbeams and stringer connections that showed overstrain for many years and called for close watching and early reinforcement. The security of bridges in the United States is safeguarded by careful and critical periodic inspection. If this is not done, defects may develop and may come to a crisis under the passage of a locomotive, causing an accident. Very often the accident should be charged up to the motive power to which the bridge had been subjected for a considerable period of time previous to the accident. On the other hand, particular locomotives occasionally develop particular defects due to being out of balance, flat wheels or other causes. In one case, a great many broken bridge stringers were reported on a line and were traced back to a particular locomotive. At one time on the Pennsylvania R.R. the breakage of about one hundred rails in the track was traced back to one particular locomotive on one trip. In both of these instances the locomotive that caused the damage was of the same type as had been in regular service on the lines.

Bridges on railroads are designed to carry the traffic safely. There has been a great change in the character and weight of locomotives and cars used. With the greater development of railroad operations in America, greater study has been given to the question of specification and design, and great progress has been made. American practice has changed rapidly due to change in conditions, and the change is as great as any possible difference between European and American practice.

The building of a heavier structure does not in itself demonstrate a waste of money. It may, on the other hand, be economy on account of the many conditions of operation, maintenance, repair and future service and availability to be taken into consideration. It must also be borne in mind that in bridge building, as in other major activities, different ideas develop. Every country, every section, every railroad and every engineer has some special practice due to certain ideas and ideals.

Computations for design cover only one particular phase of the matter of bridge work. Well rounded, long continued previous experience on important work is an absolutely essential prerequisite to accomplish the best result. Every individual problem has something special about it

and demands special treatment. Every great engineer has developed a sixth sense in his branch of the profession, and can diagnose the particular problem presented, and determine on the proper treatment.

China's practice and its problems in bridge engineering can only be settled after an intensive study of all antecedent basic conditions to be satisfied, and the exercise of the mature deliberative judgment and decision of properly trained levelheaded engineers who have had long previous experience on important work. I. F. STERN.

Chicago, Aug. 13.

Sir—I have looked over P. H. Chen's article in your issue of July 14, p. 58. The information given is entirely insufficient to serve as basis for any reasonable discussion. There is one feature, however, that stands out even in the skeleton diagram shown by the author. In this country we are obliged to build all of our through bridges with an overhead clearance of at least 22 ft., as our trainmen walk over the tops of the cars. In Europe I believe this is not the case, and if their bridges have 16 to 18 ft. clear headroom that is considered sufficient. A. F. ROBINSON,

Bridge Engineer, A. T. & S. F. Ry. System.

Chicago, Aug. 9.

Protection of River Banks with Spur Dikes

Sir—I wish to add to the discussion which has gone on in your columns for the past two months in regard to the protection of river banks with spur dikes, by giving my experience in this matter.

After testing various forms of spur dikes and other bank protection on the torrential streams in this state, I finally arrived at the conclusion that the best results were obtained by interposing obstructions which did not stop or divert the flow entirely, but which retarded the velocity sufficiently to overcome the scouring action, or to cause deposits of the suspended material, as the case might be. I produced this result in various ways, according to conditions obtaining on the streams with which I dealt.

I had a condition similar to that mentioned by Wm. G. Atwood in his letter, *Engineering News-Record*, July 14, 1921, p. 78, where the river was continually enroaching by undercutting the left bank, and the sand bar on the right was continually extending farther into the river. By running a wire fence with the wire spaced 6 in. apart across this bend, as shown in Fig. 1, and excavating a narrow channel across the bar, the space between the fence and the bank was filled to the height of the top of the fence during one season's flood, and the new channel widened to carry the total flow. It should be stated that the sand carried was very fine and that the river bed, during low water periods, was composed of quicksand.

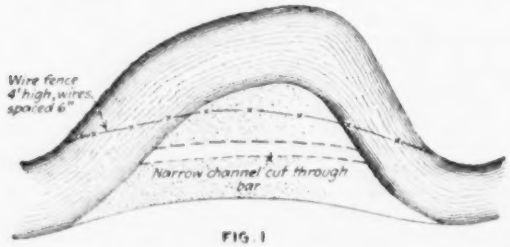


FIG. 1

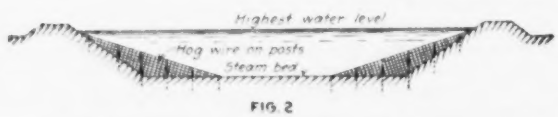


FIG. 2

WIRE FENCING AS RIVER BANK PROTECTION

I have had considerable success in stopping the scouring on the steep banks or levees of flood channels by building spurs at the critical points, consisting either of board fences of one by four rails, nailed to posts at about twelve (12) inch spacing, or by wire mesh, commonly known as hog wire, nailed to the posts. I have caused the slopes of banks to be more gradual, forming good beaches, which are the best bank protection, by means of placing this hog wire in the manner shown in Fig. 2.

I wish to add that on a recent trip over the reclamation works on the Sacramento River, I noted that many banks were efficiently protected by means of mattresses consisting of one by four boards laid as an open grill and weighted with concrete blocks. The proportion of openings was much greater than the area of the lumber, which merely had a retarding effect. This form of bank protection has the advantage of being capable of being launched for emergency protection during the flood.

W. C. HAMMATT,

San Francisco, July 22. Consulting Engineer.

Liberal Studies for the Man from the Ranks

Sir—Professor Burr and his commentators in the pages of the *Engineering News-Record* have, to my mind, touched only upon one phase of the problem.

It is perhaps natural that professional men who are themselves college or engineering school graduates should think of the problem only in terms of the man who has spent from four to six years at college, engineer or otherwise. There is another factor in the problem, the man who has not been able to go to college, but who, through love of engineering work or through other considerations, enters the profession at the foot and works his way up, obtaining such technical education as he may, through the medium of correspondence schools, evening technical schools, or text-books.

For such men, although a college man myself, I have a very great sympathy, and, in many cases, a hearty admiration.

What may be the proportion of men of this type to the "regular" engineer I do not pretend to know, but I do know that in a local section of one of the national engineering societies, a very large proportion is not college taught. These men, in many cases, call themselves engineers, and, in many cases, Mr. Gustavus to the contrary notwithstanding, have no reason to be ashamed of their work, or their "blunders." It is significant that of the letters printed upon the subject, only Mr. Gustavus mentions the practical man, and he only disparagingly, although the public which come into contact with these men regard them as just as much engineers as their college-taught brethren. Is it not time that something in the way of a broader education, liberal as well as technical, were done for these men?

In every city of any importance there is at least one evening school giving instruction in technical subjects. Most of the courses, however, are arranged so that it is optional with the student to take some of the subjects, and while the faculty advises the student to correlate his studies there is no real compulsion upon him to do so.

There is need for an engineering course to cover four or five years of work of from six to ten hours a week, and comprising every subject that is treated of in the daytime. This may or may not have as prerequisite a high school education, and should not interfere with present courses in elementary subjects or shop work intended for mechanics in various trades.

One could elaborate on this subject indefinitely, but I do not wish to take up more of your space or time.

The editor of *Engineering News-Record* once wrote that "Journeyman engineering is the skeleton of the profession." The men of whom I write are journeymen engineers, they are accepted by the public as engineers, and no project for uplifting the status of the engineer, through education, that does not take these men into consideration, can succeed.

They must be given greater educational facilities, not merely technical, as at present, but with as many of the liberal subjects as may be necessary. JAMES TATE,

Chicago, Ill., Aug. 20, 1921. Mechanical Engineer.

HINTS FOR THE CONTRACTOR

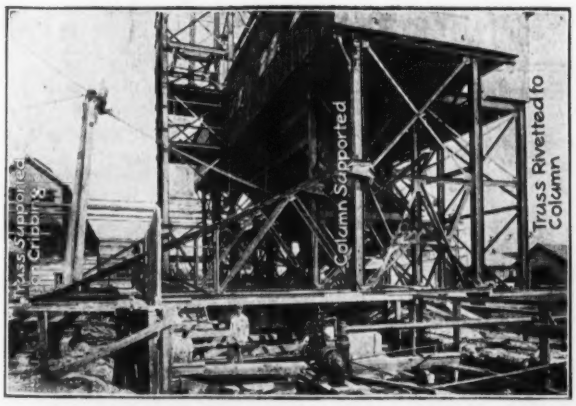
Temporary Trusses Support Columns

BY EDWARD U. SMITH
Division Engineer, the Austin Co., Philadelphia, Pa.

BY CONSTRUCTING across-pit trusses to support columns over an excavation for a concrete tank, time was saved, which was highly important, and water-tight construction was assured in building a recent sintering plant for the National Analine & Chemical Co., at Marcus Hook, Pa. The alternative method of shoring up the columns and deepening the footings before excavating the tank emplacement would have cost less, but the construction would have taken longer than the permitted 45 working days, and the waterproofing of the pit could not have been guaranteed.

One side and one end of the tank were directly under five steel columns of the sintering plant, as indicated by the view. The original concrete footings were about 4 ft. 6 in. deep. It was therefore necessary to remove the footings from under the columns before any concrete could be poured. Two of the columns, forming a part of the tower, were about 90 ft. high and were designed to support a total load of 200,000 lb. each. The other three columns were a part of the sintering plant proper, were about 50 ft. high and were designed to support a total load of 90,000 lb. each. The sintering plant was not entirely completed. An analysis of the weight of the structure, as it stood, showed that the load on the columns was about 25 per cent of the capacity and the loadings of 200,000 lb. and 90,000 lb. were consequently reduced 75 per cent.

The trusses were designed for a fiber stress of 18,000 lb. per square inch and l/r was taken at 180.



LIGHT STEEL TRUSSES CARRY COLUMNS OVER EXCAVATION

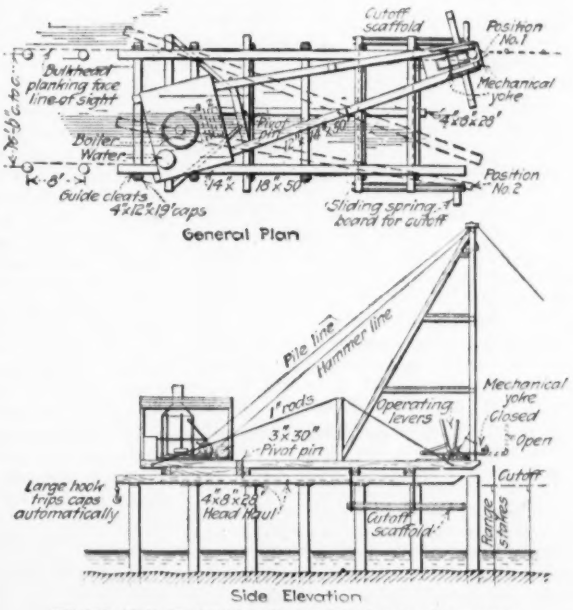
The total length of the bottom chord was 42 ft. 10 in.; one end was connected to one of the sintering building columns 14 ft. away from the column supported, while the other end rested on cribbing placed about 10 ft. away from the side of the caisson. As settlement of the earth was expected under the cribbing, this end was placed 1½ in. above its required elevation. The caisson was 87 ft. long, 24 ft. 6 in. wide and 20 ft. deep. The sheeting was driven by hand. The excavation was handled by a stiff-leg derrick and a one-yard bucket, and the pit was kept dry by a steam pump. The contractors were The Austin Co., Cleveland, Ohio.

Pivot Piledriver Has Special Features

BY B. E. TORPEN
Aberdeen, Washington

A PIVOT piledriver with a mechanical yoke and several other features was used by the man who devised the equipment, J. S. Creech, in driving bulkhead piling in the development of the port of Grays Harbor, Wash. Included in the devices with which the piledriver are fitted besides the mechanical yoke, are, a special sled on which the driver rests, a device for removing temporary capping as the driver moves forward, and a cut-off scaffold attached to the driver platform.

The mechanical yoke is a simple device adjustable



PLAN AND ELEVATION OF PIVOT PILEDRIVER

under pressure without stopping the hammer. It is operated by levers placed directly behind the leads.

The piledriver is mounted on a special sled to which it is fastened by a 3-in. x 30-in. bolt placed so that the driver can pivot. The sled is the same width as the bent and cleats on caps guide the runners in a true line.

A 6 in. x 8 in. x 28-ft. "ginny stick," on the bottom of which at 8-ft. intervals are cleats and sheet-iron guides, lies on the 4 in. x 12 in. x 18-ft. caps. It is pulled ahead after each move with the haul-back line. The head-haul is attached to this ginny stick, passes back to the spool and pulls the driver ahead on greased caps.

The caps are prevented from pulling off the piling by iron shoes or dogs that sink into the pile heads. As the driver moves ahead a large hook hanging from the rear pulls the cap from the piling behind the runner. The cap is then pulled forward and placed with the pile line. There is a scaffold on each side of the driver platform from which the piles are cut off before capping.

On this job the average day's work has been forty piles of a length of 40 ft., with a penetration of about 30 ft. through tidal flat mud. The best day's run was sixty-five piles. The cost to drive this number was 2 cents per foot, with common labor being paid $6 per day.

NEWS OF THE WEEK

New York, September 1, 1921

Senate Resolution Calls for Probe of Federal Road Expenditures

After long delay, Senator King of Utah has introduced his much-heralded resolution providing for an investigation of the expenditure of federal money in connection with highway construction. Senator King takes the position that since Congress has appropriated large sums of money for federal aid and has distributed to the states federal property valued at more than $100,000,000, an official commission should investigate the report that the money and the property "have been used and expended in an extravagant and wasteful manner and that the road construction actually accomplished has not been commensurate with the labor and moneys expended and has otherwise been faulty, insecure, superficial and lacking in permanence."

The commission prescribed in the King resolution is to consist of three specially qualified engineers to be designated by the President. Two of the engineers are to be chosen from the Corps of Engineers, U. S. Army, and one from civilian engineers. The resolution carries an appropriation of $50,000 to be used by the commission in its investigation.

I. C. C. Approves Idaho Central 90-Mile Cut-Off

A certificate of public convenience authorizing the Idaho Central R.R. to construct a line of railroad 90 miles in length has been issued by the Interstate Commerce Commission. The line will connect Rogerson, Idaho, the southern terminus of a branch of the Oregon Short Line extending from Minidoka, Idaho, and Wells, Nev., the junction point of the Central Pacific line of the Southern Pacific Company and the Western Pacific R.R. The exact location of the proposed line is undetermined and no preliminary survey has been completed. It is stated that the new line will shorten the distance between Twin Falls, Idaho, and San Francisco by 311 miles as in comparison with the present route over the Oregon Short Line and the Southern Pacific.

Drainage Survey for Indiana

A survey of the streams and drainage districts of Indiana is to be made by the new engineering division of the State Conservation Department, the maps and records being assembled for use in advisory work on future drainage projects. This engineering division was created recently by the legislature, and the drainage survey will be made under the direction of M. J. Stinchfield, Jr., assistant state engineer.

First Skagit Plant Unit Completed

The initial unit in the Skagit hydroelectric development for the city of Seattle, Wash., the 3,000-hp. plant at Newhalen Creek, on the Skagit River, has been completed and put in operation. This unit is primarily to give power for construction purposes on the rest of the project.

City Planning Studies to Be Made for Cincinnati

The City Planning Commission of Cincinnati, Ohio, has engaged the Technical Advisory Corporation, consulting engineers, New York City, to make studies preliminary to the carrying out of a proposed unusually complete city plan. A comprehensive outline of the proposed studies has been agreed upon. The main topics are public and private services, circulation, waterways, civic improvements, recreation, municipal control and direction of private property, finance and administration. An "order of urgency" for the various subjects studied is proposed, and it is hoped that something can be worked out for the co-ordination of the Cincinnati city planning work with planning for the entire Cincinnati metropolitan area. W. D. Ennis is vice-president of the Technical Advisory Corporation, and E. P. Goodrich and George B. Ford are included in the staff of city planning experts.

Fire in Hoboken Shipping Piers

On Aug. 24 a fire practically destroyed two of the piers in the group at Hoboken, N. J., used by the Army since early in the war as an overseas transport base, slightly damaged the steamship "Leviathan" which has been moored at one of the piers for some years and damaged a number of buildings on the marginal street. Early reports much exaggerated the amount of damage done, but the full details must await the report of the army board of review, which is withholding all the evidence in the case.

Piers 5 and 6, which were destroyed, are the most southerly of the group which, before the war, was controlled by the German shipping companies. These two were the property of the Hamburg-American Line and were the only ones of the group not replaced after the fire of 1900 which destroyed all the remaining piers. They were about 40 years old, of timber construction and not well protected against the fire, which originated in one of them and threatened at one time to wipe out the whole reservation as well as a part of the city.

Federation Makes Plans for Engineering Assembly

Three-Day Session Probable—Executive Board to Choose Hoover's Successor as President

At the meeting of the executive board of the American Engineering Council, to be held at the Cosmos Club, Washington, D. C., Sept. 30, the most important business will be the election of a president to succeed Herbert Hoover, who resigned after he became Secretary of Commerce. Nominations to fill this vacancy were ordered at the last meeting of the executive board so that they could be reported at the September meeting. Some of the other items which have been before the executive board will come up for further consideration. Special attention will be given the plans for the engineering assembly, extension of employment service, and the licensing and registration of engineers.

The engineering assembly committee has been appointed, with A. P. Davis as chairman; other members are Philip N. Moore, L. P. Alford, John C. Hoyt and F. A. Vaughn. This committee will work out detailed plans for an assembly to be held in conjunction with the annual meeting of the American Engineering Council, the assembly having been authorized by the special vote of the executive board at the Philadelphia meeting. Present plans are to make this assembly a three-day session, starting between the middle and latter part of January. In general, one day will be given to special meetings of the executive boards of member organizations and committees of the council, one day will be given to the sessions of the council, and at least one day will be devoted to the discussion of some special topic such as elimination of waste, licensing or the public works department.

On the question of licensing of engineers it is contemplated that the council's licensing committee will be able to submit a complete report to the board as a result of hearings to be held before the committee on this subject. The executive board instructed its committee to proceed with hearings on this subject as a basis for further reviewing and changing the model licensing law.

It is contemplated that the committee on classification of engineers will report its recommendations to the council at the next meeting.

New Construction Course

The extension division of the University of Wisconsin has added to its curriculum a course for superintendents of construction, under Professor Hool.

Minnesota State Registration Board Organizes

The state board for the registration of architects, professional engineers and land surveyors in Minnesota has organized with Paul Doty as chairman and H. T. Downs, Minneapolis, as secretary-treasurer. Applications of those entitled to registration without examination are being received.

Indiana Board Names Officers

D. V. Moore of Indianapolis, was elected permanent secretary of the Indiana state board for registration of professional engineers and surveyors at the first meeting of the board recently. The secretary is not a member of the board. He will receive a salary of $3,000 a year. R. L. McCormick of Rose Polytechnic, Terre Haute, was elected chairman of the board, and Ray Seely, Lake County surveyor, was named vice-chairman.

Status of Engineer Registration Board Member in Doubt

Gov. McCray of Indiana has requested an opinion from U. S. Lesh, attorney-general, as to the eligibility of Ray Seely, Lake county surveyor, to serve as a member of the newly-created state board for the registration of professional engineers and surveyors. In an unofficial opinion last March, Mr. Lesh ruled that a county engineer could not serve on the state board because of the provision in the state constitution against the holding by one person of two lucrative public offices at the same time. He said today that in view of the governor's request he was checking up on his former opinion, which he seemed inclined to think was correct.

If the attorney-general decides that in appointing Mr. Seely to the board the constitutional provision was violated, the governor will have no other choice than to request Mr. Seely's resignation. It is not expected that the latter will offer any resistance, but that he may even submit his resignation to the governor to end the situation.

A. N. Johnson Heads Good Roads Essay Board

Three judges will constitute a national committee to award the four years university scholarship offered for the best essay written on the subject "Good Roads and Highway Transport" in a national contest among high school pupils conducted under the auspices of the Highway and Highway Transport Education Committee which has headquarters at Washington, D. C. The judges will be Dean A. N. Johnson, department of engineering, University of Maryland, chairman; Harford Powel, Jr., editor *Collier's Weekly*, and C. H. Huston, assistant secretary, Department of Commerce. The Scholarship, which has a value of about $4,000, is the gift of H. S. Firestone of Akron, Ohio, a member of the committee, offered at the request of his associates.

Cleveland Mayor Joins Plea for Station Rehearing

Following the action of the New York Central, the Big Four, and the Nickel Plate in filing a plea for a rehearing of the Cleveland Public Square passenger terminal case, recently dismissed by the Interstate Commerce Commission, W. S. Fitzgerald, mayor of Cleveland, has filed a separate plea for a rehearing. Among the reasons which he gives is that Cleveland should not be discriminated against by refusing it adequate freight and passenger facilities.

U. S. Assistant Engineers' Salaries Now Standardized

Since Nov. 20, 1920, the engineer assistants of the United States Engineer Department have been classified and graded as to salaries. Prior to that time, there were many inequities in the matter of salary. In some cases when additional remuneration would be recommended for an assistant engineer, for instance, the Secretary of War would grant the increase. Perhaps the very next month an increase would be recommended for an equally deserving assistant engineer but would meet with approval.

One of the first things undertaken by Major-General Lansing H. Beach, when he became chief of engineers, was to undertake the classification and standardization of these salaries. His recommendations in this regard were accepted in their entirety by the Secretary of War. In the aggregate, this added nearly half a million dollars to the payroll of the Corps of Engineers.

Under this new scale, six assistant engineers receive a salary of $4,500 a year, twelve receive $4,200, twenty-four $3,900, thirty-six $3,600, forty-eight $3,300, and thirty $3,000.

Superintendents are classified as follows: Two at $3,900, two at $3,600, two at $3,300, two at $3,000, and six at $2,400.

Junior engineers are classified as follows: Three at $3,000, thirty at $2,700, and 100 at $2,400.

Chief clerks, who must be very familiar with engineering matters, are classified as follows: Six at $3,000, twelve at $2,700, and thirty at $2,400.

Taft Appoints Dean Hayford on Boundary Commission

John F. Hayford, dean, college of engineering, Northwestern University, has been appointed by Chief Justice Taft as a member of the commission to determine the boundary between Costa Rica and Panama which was recently the cause of trouble between the two Central American Republics. The treaty between Costa Rica and Panama provided that each country should name one engineer and the United States two, to determine a boundary which was to be finally adjudged by the Chief Justice of the United States. The other United States appointee is O. M. Lekinol, dean, college of engineering, University of Minnesota.

Epes Randolph, Railroad Executive, Dead

A Pioneer in Development of the West —Averted Colorado River Disaster by Quick Action

Epes Randoph, president of the Arizona Eastern R.R. and the Southern Pacific R.R. of Mexico, died in Tucson, Ariz., Aug. 22, 1921. Although he had been suffering from tuberculosis for years, Mr. Randolph was known as one of the most accomplished engineers and able railroad executives of the time. He was in direct charge of the work successfully carried out by the Southern Pacific Co. in turning back the waters of the Colorado River when the whole of the Imperial Valley was threatened with inundation.

Mr. Randolph had been in the service of the Southern Pacific since 1895, having entered railroad work in 1876. He was assistant, locating, resident, and division engineer of various railways including the Alabama Great Southern, Chesapeake, Ohio & Southwestern, and the Kentucky Central, in location, construction, and maintenance work.

In 1885-1890 he was chief engineer of the Kentucky Central and chief engineer of the Cincinnati Elevated Railway Transfer & Bridge Co., in charge of the construction of the bridge across the Ohio River between Covington and Cincinnati. He then became chief engineer and superintendent of the Newport News & Mississippi Valley Co., Ohio & Big Sandy R.R., and Kentucky & South Atlantic R.R. at Lexington. Afterward he served as chief engineer and superintendent of the Chesapeake, Ohio & Southwestern, and Ohio Valley railroads at Louisville.

Served Harriman Interests

In 1894 Mr. Randolph was forced to retire from railroad service on account of ill health and went to California. Soon afterward he became superintendent of Southern Pacific Co. lines in Arizona and New Mexico, with headquarters at Tucson, Ariz., and in 1901 he was appointed vice-president and general manager of the Los Angeles Ry. and the Pacific Electric Ry. in charge of locating, building, and operating some 700 miles of electric railroad. Following the building of the Pacific Electric he acted as the chief executive of the Huntington and Harriman interests in acquiring and consolidating the lines that now comprise the Southern Pacific properties in Arizona. In 1911 he became president of the Southern Pacific Railroad Co. of Mexico and the Arizona Eastern R.R.

In 1905 he was appointed president of the California Development Co. and was in direct charge of the work of turning back the Colorado River into its original channel after it had flowed into the Salton Sink for two years, creating a lake fifty miles long and fifteen miles wide, which threatened to inundate the whole of the Imperial Valley.

An old officer of the Southern Pacific says of Mr. Randolph:

"A born leader of men, Mr. Randolph will always be remembered for his courage, ability, and determination as an engineer and railroad officer. Gripped by tuberculosis in the prime of life, his work and his career were hampered but not checked. In spite of his failing health he was one of the great engineers of the generation, and only his affliction prevented his being one of the greatest railroad operators ever known.

"Remarkable as it may seem, most of his important work was carried out after his health had failed. He was a pioneer in the development of the West and it was he who ran the location line and then the construction of the Southern Pacific westward to meet the line being built by William Hood. Through his foresight and ability the Southern Pacific of Mexico was built and control of the present Southern Pacific lines in Arizona acquired.

"Although suffering severely and believed by his subordinates at the point of death, he remained in active charge at the site of the closure of the new Colorado River channel and turned back the waters when 48 hours more would have meant disaster for the whole of the Imperial Valley.

"Regardless of titles, Mr. Randolph was chief wherever he was. Born a master of men, he was known by everyone for his consideration and courtesy."

Missouri's $60,000,000 Highway Bill Becomes Law

The bill providing for a state highway system for Missouri to be constructed from the proceeds of the $60,000,000 bond issue, approved at the last general election, became a law late last month. The new act provides for the expenditure of $31,000,000 on 7,300 miles of gravel roads and of $29,000,000 for 1,500 miles of hard-surfaced highways of a more durable type. There is a restriction in the measure which prevents the issuance of any bonds until March 1, 1923, when a total of $10,000,000 is provided for. After that date bonds will be issued in sums of $5,000,000 annually. A state highway commission of four members is to be appointed.

Am. Soc. C. E. Resumes Publication of Papers and Discussions

In the August issue of its *Proceedings*, just issued, the American Society of Civil Engineers announces a reversion to its practice of publishing papers and all discussions in its monthly journal instead of in pamphlet form. As a measure of economy, during the war period, the publication in the *Proceedings* of the material above mentioned was discontinued and members were supplied with papers and discussions in pamphlet form on request. The change met with widespread objection. The procedure now in force is exactly the same as that followed before the move to cut down on the cost of publication was made.

No Agreement on Road Bill

After the passage of the highway bill by the Senate, it became evident that the differences between it and the bill passed by the House could not be reconciled without extended conferences. The result was that no effort was made to conduct a conference on the bill prior to the congressional recess. An additional reason is that there is opposition among House leaders to any appropriation at this time for highway construction.

New Form of Meetings Are Announced for Am. Soc. C. E.

Departing from its former practice of devoting its regular meetings to a single technical paper and discussion thereof, the American Society of Civil Engineers has made an innovation in its program for this fall by announcing five meetings at which important national subjects will be discussed by several speakers at a number of sessions.

The first meeting, according to the announcement of Elbert M. Chandler, acting secretary, will be held in the Engineering Societies Building, New York City, Sept. 7, and will continue during two sessions, afternoon and evening the following day. The subject is "National Port Problems." A list of the speakers and their subjects for the Sept. 7-8 sessions follows:

Sept. 7, 7:45 p.m.—Frederic W. Cowie, chief engineer, Harbor Commissioners of Montreal, "National Phases of Port Problems"; Major-Gen. Lansing H. Beach, Chief of Engineers, U. S. Army, "Terminals"; Frederic H. Fay, of Fay, Spofford & Thorndike, consulting engineers, Boston, "Development of the Smaller Ports"; M. A. Long, of the M. A. Long Co., engineers and constructors, Baltimore, "Relation of Warehouses to Port Development."

Sept. 8, 2 p.m.—John Meigs, consulting engineer, Philadelphia, "Unco-ordinated Design in American Ports"; W. Watters Pagon, consulting engineer, Baltimore, "Brief Comparison of American and Foreign Sea Ports"; Edwin J. Clapp, New York City, "Some Observations on Port Finances"; Carrol R. Thompson, assistant director Department of Wharves, Docks and Ferries, Philadelphia, "Improvement and Development of Ports."

Sept. 8, 7:45 p.m.—J. A. Bensel, consulting engineer, New York City, "Port Problems in New York"; Colonel W. J. Wilgus, consulting engineer, New York City, "Relationship of Rail and Water Carriers"; B. F. Cresson, Jr., chief engineer, the Port of New York Authority, N. Y., "Port Administration"; H. McL. Harding, designing terminal engineer, New York City, "Pier Designs as Developed from Quay Designs."

The meeting to be held Oct. 5 will deal with the flood problem, water power development and stream control. On Nov. 16 there will be a general conference on the problems of sanitation and the following month the regular meeting of the society, to be held Dec. 7, will be given over to a discussion of the progress report of the joint committee on standard specifications for concrete and reinforced concrete. "The National Housing Problem" will be the subject at the meeting of Jan. 4.

Engineering Societies

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, New York, N. Y.; Semi-Centennial Anniversary, Wilkes-Barre, Pa., Sept. 12-15.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Bridgeport, Conn., Sept. 13-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

The New England Water Works Association announces as a feature of its annual convention, to be held in Bridgeport, Conn., Sept. 13-16, a golf tournament at the Brooklawn Country Club. Prizes have been provided by the Water Works Manufacturers' Association. Entries should be sent to Egbert D. Case, Pitometer Co., 50 Church St., New York.

Personal Notes

MILTON H. FREEMAN has been designated as acting chief engineer to the New York-New Jersey Tunnel Commissions during the absence of Clifford M. Holland, chief engineer, who is making an inspection of vehicular tunnels in Europe.

W. C. HIGHT, formerly principal assistant engineer, Arkansas Highway Department, has been appointed district engineer, district No. 2, with headquarters at Fayetteville.

ELBERT B. REYNOLDS, for several years connected with the Arkansas Highway Department, has been appointed district engineer, district No. 3, with headquarters at Hope.

G. HUNTER SYKES, formerly U. S. highway engineer, Bureau of Public Roads, Fort Worth, Tex., has been appointed district engineer, district No. 3, with headquarters at Little Rock, Ark.

C. W. KOINER, for 13 years general manager and mechanical and electrical enginer of Pasadena's Municipal Light and Power Department, has been appointed city manager of Pasadena, Cal.

FORD, BACON & DAVIS, engineers, with offices in New York, and

San Francisco, have established an office in Philadelphia.

MONROE DOUGLAS ROBINSON has been made vice-president of the T. C. Desmond Co., engineers and contractors, New York City. Mr. Robinson will devote his attention to the New York office of the company, which has branches in Newburgh, N. Y., and Hartford, Conn.

J. L. CLARKSON, formerly general secretary of the National Federation of Construction Industries, Philadelphia, Pa., has been appointed assistant to the president of the John R. Wiggins Co., Inc., builders, Philadelphia, Pa.

WARNER S. HAYS, consulting engineer of Philadelphia, Pa., has been appointed general secretary of the National Federation of Construction Industries, Philadelphia, Pa.

ARCHER R. NORCROSS, hydraulic and sanitary engineer connected with the civil engineering department, North Dakota Agricultural College, has resigned to accept a similar position with the structural and hydraulic engineering department, University of West Virginia.

JAMES OLIVER HOGG has resigned his position as construction engineer with Collins Bros., general contractors in Kansas City, Mo., to become superintendent of construction for the school board of that city.

CLARENCE E. RIDLEY, who for two and a half years was city engineer and superintendent of the water department at Port Arthur, Tex., has just been appointed city manager of Bluefield, W. Va., and will assume charge Sept. 1. Mr. Ridley has completed on one-year course of training at the National Institute of Public Administration, New York City.

A. B. MCDANIEL, formerly principal engineer of the construction division of the army, has been appointed educational specialist on the advisory board of the general staff of the army.

ALBERT GIVAN has been appointed city engineer of Sacramento, Cal., to succeed Frank C. Miller.

F. O. DUFOUR has resigned as structural engineer of Stone & Webster, Inc., to accept the chair of the Simon Cameron Long professorship of civil engineering at Lafayette College and the directorship of the Testing Laboratory. Mr. Dufour will take up his duties at the beginning of the college year in September.

B. G. DANN, who for the past four years has been connected with the engineering department of the Truscon Steel Co., Youngstown, Ohio, and New York City, has resigned to accept a position as manager of the New York office of the Hendrick Manufacturing Co., makers of perforated metal screens, elevator buckets, general sheet and light structural work, also light and heavy steel plate construction. Mr. Dann is a graduate of the engineering department of Lafayette College.

GEORGE C. D. LENTH, assistant chief engineer, sewers, Board of Local Improvements, Chicago, has been appointed secretary of the Clay Products Association to succeed the late George H. Teft. Mr. Lenth has been with the board for 16 years, since 1911, as assistant chief.

W. W. SCHLECHT, who recently resigned as project manager, Yuma project, U. S. Reclamation Service, has become associated with Dwight P. Robinson & Co. He has been detailed for them on work at Fortaleza, Ceara, Brazil.

PROF. E. G. SMITH, for 40 years professor of chemistry in Beloit College has retired. He was one of the early sanitary chemists of the Middle West who took up bacteriology as a valuable adjunct to chemical constituents as an indicator of the quality of water supplies. More than 100 cities employed him in connection with the quality of their water systems.

WALTER R. SCHEINER, at one time county engineer of Sumner County, Kan., has been appointed city engineer of Salina, Kan., succeeding Paul G. Wakenhut.

COL. CLARENCE S. COE, formerly commanding officer, 17th Engineers (Railway), which was demobilized at Atlanta, Ga., in 1919, after an extended period of service at St. Nazaire, France, and later adviser to the government of the Kingdom of the Serbs, Croats and Slovenes in Servia, has been appointed city manager of Miami, Fla., under the commission manager form of government.

OBITUARY

PETER COOPER HEWITT, scientist and electrical inventor, died in Paris, Aug. 25. He was born in New York City, 1861. He attended Stevens Institute of Technology and Columbia University and received the honorary degree of Sc. D. from Columbia in 1903 and from Rutgers College in 1916. He was a director of the Cooper Hewitt Electric Co., New York, and Greenwood Lake Ry., Cooper, Hewitt & Co., Midvale Water Co., Hexagon Realty Co., Hewitt Realty Co. He was made vice-president of the Naval Consulting Board in 1915 and was a trustee of Cooper Union for Advancement of Science and Art. Mr. Hewitt was the inventor of the mercury vapor lamp which bears his name.

CONRAD FREYTAG, head of the Wayss & Freytag Co., of Neustadt, Germany, one of the pioneers of reinforced concrete in Europe, died July 2 in Wiesbaden at the age of 75. He bought the Monier patents in 1884, and a few years later, with G. A. Wayss, began active development of reinforced-concrete construction. He was one of the founders of the German Concrete Society, which made him an honorary member two years ago.

EQUIPMENT AND MATERIALS

Ditch-Cleaning Machine

The machine illustrated has been devised for cleaning small drainage and irrigation ditches. It has a curved blade 5 ft. long, with detachable shares on both edges. The beam is fitted at each end with plow-steel fins which take the side draft.

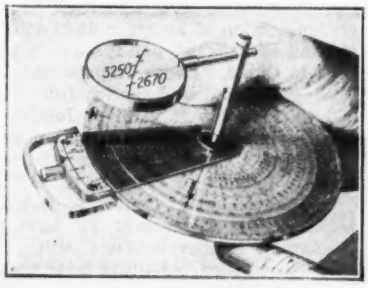
The blade can be set at any angle and can be adjusted for varying depth

of ditch. To reverse the machine, it is simply turned over, the only adjustment being to disconnect the draft beams and then attach them to the lower edge of the blade. The plow may be hauled by horses or a small farm tractor.

It is built by the Western Wheeled Scraper Co., Aurora, Ill.

Improved Rapid Computer

The Computer Manufacturing Co., of San Francisco, is putting out a new type of Ross Rapid Computer. Instead of being of celluloid, as was its predecessor, it is an all-metal instrument arranged for desk mounting as well as



for hand use. It is mounted on aluminum, is ¼ in. thick, and weighs ½ lb. The diameter of the outside scale is 5 in.

In graduation it is like the original instrument, being built on the principle of the polyphase duplex slide rule. Besides the logarithmic scales, it has a 360 deg. protractor, scales of radians and of cubes, and complete trigonometric scales from 0 to 90 deg. for all six functions. An accuracy of 1/20 of 1 per cent can be secured, if the settings are within 4½ min. of arc, which, it is claimed, is easily attained by the practiced hand. The centering, graduations, and hair lines have been made consistent with this accuracy.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Engineering News-Record Construction Cost Index Number

September, 1921	188.27
August, 1921	193.47
September, 1920	248.40
Peak, July, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 5.2 (2.7 per cent) lower than this time last month, owing to decreases in lumber and labor. The pine base in New York is now $45 (to contractors) as against $47 last month. Lowered rates for common labor in Cleveland and Baltimore have brought down the average for the country from 53½c. per hour in August to 51c. The Pittsburgh base on structural shapes, $1.85, is still effective. Cement still sells for $2.17 net in Chicago. Thus, general construction cost is 24 per cent cheaper than one year ago and 31 per cent under the peak.

Large Lumber Shipments Go from Puget Sound to Orient

A recent check by Puget Sound lumbermen shows that 20,000,000 ft. b.m. of lumber for house construction will be carried from Puget Sound to Japan in August and September by Seattle's transpacific fleets. The shipments form one of the greatest movements of the kind in recent years. In addition to the movement to Japan, all the ocean transportation companies in the Northwest are figuring on the transportation of an order of 11,000,000 ft. b.m. of railroad ties for a new railroad in China. Every transpacific ship leaving Puget Sound carries from 250,000 to 1,000,000 ft. b.m. of lumber in her Japanese cargo. The shipments consist of 4 x 4-in. and 5 x 5-in. timbers, in lengths of from 10 to 13 ft.

The movement of lumber to Japan is regarded as a forecast of how the Northwest lumber industry will prosper when other old-world nations adjust their affairs.

Work for Worcester Unemployed

Additional men are to be employed in Worcester, Mass., as the opportunity arises to put them to work, as a means of relieving unemployment. Permission has been secured from the state civil service commission to employ idle men on emergency work, and acting upon that authority 200 men were put to work recently. It is the plan of the city officials to give the men one week of work followed by a week layoff. Two large construction jobs are under way upon which the men are employed—the building of a dam and the construction of a sewage disposal plant.

Value of August 1921 Contracts Exceeds that of the Same Month Last Year by 15 Per Cent

Miscellaneous Building, 50 Per Cent, Street and Road Work 55 Per Cent More—Month's Total Is $104,644,115

For the first time this year the total value of contracts let, as reported in *Engineering News-Record*, exceeded the total value reported for a corresponding month in 1920, in August. The total value of contracts let in August, 1921, was $104,644,115 as compared to $92,661,818, the value of contracts let during August, 1920. The value of contracts let during the past month is 5 per cent more than the average monthly value for the year so far, whereas the August, 1920, contracts were valued at only 62 per cent of the eight-month average. The total value of contracts let now for the first eight months of the two years are as follows: 1920, $1,180,632,145; 1921, $789,904,941. No account is made of residential building nor of housing projects, except those of an industrial character.

There are several remarkable facts in the comparison of the contracts let for August of the two years. In the first place, it is found that during August, 1921, the total value of miscellaneous building amounted to more than $50,000,000 as compared with $33,000,000 during the same month of 1920, an increase this year over last of approximately 50 per cent. A still greater increase is noted this year over last in street and highway work, the total contract value in these two classes of construction being as follows: 1920, $18,564,595; 1921, $28,692,878. This shows an increase during the past month over the corresponding month of 1920 of 55 per cent.

VALUE OF CONTRACTS LET DURING AUGUST OF 1920 AND 1921

Classification	August, 1920	August, 1921
Waterworks	$775,302	$2,404,304
Sewers	2,437,384	3,988,318
Bridges	2,172,717	2,353,227
Streets, roads	18,564,595	28,692,878
Excavation	4,179,485	89,403
Industrial	25,941,992	7,210,378
Buildings	33,492,290	50,475,001
Federal government	1,687,499	1,355,545
Miscellaneous	3,410,554	8,075,061
Total	$92,661,818	$104,644,115

In only three out of nine classifications of construction work did August, 1920, exceed August, 1921. These three classifications are excavation and dredging work, industrial building and Federal Government work. In industrial work 1920 has always far outdistanced 1921 in the total value of contracts let, as there is comparatively little industrial building going on at the present time. The values of this class of work were, for August, 1921, and 1920, about $7,000,000 and $26,000,000 respectively.

The comparison of the total contracts let for August, 1920, and 1921, indicated above, have not taken into account the decrease in the cost of construction within the past year. Due to the deflation of prices within that period $1,000 will buy a larger proportion of construction materials than it would a year ago. Therefore, $1,000,000 will do a larger construction job now than during August, 1920. This dollar deflation is expressed in the *Engineering-News-Record* Construction Cost Index Number as about 194 now as compared with 251 for August, 1920. In other words, from August, 1920, to August, 1921, there was a deflation of construction costs of about 23 per cent. Applying this differential to the actual dollar values of construction costs for the two years, the correct values are found to be: August, 1920, $92,661,818; and August, 1921, $128,712,261. This is a direct comparison between the total contract value figuring that the dollar is worth the same amount in each instance.

There are other interesting points in the comparison of the contract value for the two years, and among them is that, following the contract values from month to month for the first eight months of each year, it is found that the trend of values was distinctly downward during last year and is climbing this year. Of course, variations from this general trend occurred at the peak of spring letting.

With the large amount of work proposed and upon which bids are being received, there is every indication that construction work will become increasingly active during the late summer and fall.

Dallas Contractors Terminate Contracts with Labor

Due partly to the deadlock that has been existing for some time between bricklayers and builders of Dallas, Texas, over the question of wage reductions, contractors of that city have initiated a movement to discontinue the making of verbal or written agreements, or entering into any contracts, with labor. Twenty-three contractors have already signed the agreement.

Only Citizens Allowed on Seattle Improvement Projects

Work on virtually all city improvement projects in Seattle was suspended temporarily by a recent order of the Board of Public Works requiring all laborers to be citizens and registered

voters. The order was issued to give employment to approximately 450 day labor jobs to citizens who are now unemployed. The order required all contractors doing street and sewer improvement work for the city to dismiss aliens and laborers holding only first papers, and to replace them by bona fide citizens, holding registration certificates. The order is based on a charter provision that citizens and residents of Seattle, as well as heads of families, shall be given preference in city employment. This rule has not been enforced in the past, with the result that most of the labor now employed is alien. The city at present is carrying on twenty improvement projects.

West Coast Lumber Production

For the week ended Aug. 20 105 lumber mills reported to the West Coast Lumbermen's Association an output of 60,647,335 ft. b.m. This is almost an 80 per cent normal cut.

Harding Calls Conference on Unemployment

President Harding has taken a hand in the attempt to solve the unemployment problem and has called a national conference to be held in Washington early in the future. The call for the conference has gone out through the Secretary of Commerce who has issued the following statement covering the situation:

"The President has decided to call a national conference at Washington on unemployment and has instructed the Department of Commerce to formulate a plan for it. Its personnel will be made up so as to represent the country geographically and so far as possible to embrace representatives of the greater employment industries. The Department of Commerce will co-operate with the Department of Labor on representation of labor.

"It is desired for working reasons to keep the number of the conference as small as possible. It is intended to invite representatives of the greater groups of industries and thought, and the co-operation of their national organizations will be sought."

"The object of the conference will be to inquire into the volume of needed employment, the distribution of unemployment, to make recommendations as to measures that can properly be taken in co-ordinated speeding up of employment by industries and public bodies during the next winter, and in addition a broad study of the economic measures desirable to ameliorate the unemployment situation and give impulse to the recovery of business and commerce to normal. Many constructive suggestions have been made to the department by employers, the governors of states, and city officials. While business steadily improves, yet some workers may have exhausted their savings by winter and they must be a matter of extreme solicitude."

It is expected that the full conference plan will be ready for the President in about ten days.

Labor Rates and Conditions Throughout the Country

Cleveland and Baltimore are the only cities of the nineteen listed showing a decrease in labor rates. In Cleveland, bricklayers, carpenters, hoisting engineers and structural iron-workers receive $1.04; hod-carriers 60c., piledrivers 91c. and common labor 57½c. per hour. Common labor in Baltimore has dropped to 30c. per hour from 35c. Minneapolis reports labor plentiful and no strike difficulties. In Detroit there is a shortage of plasterers, with all other trades plentiful, men in some cases accepting considerably less than the official scale. Housebuilding in New Orleans is much more active than in 1920, but no industrial construction is under way. Open-shop conditions still prevail in Pittsburgh, with labor reported plentiful.

Los Angeles reports employment in all classes of labor except pile-drivers and common laborers. There is practically no demand for pile-drivers and there are more men than jobs among the unskilled. Few structural iron-workers are reported idle. An aggravating feature is that men out of work flock to Los Angeles from the smaller towns. In Oakland, Cal., the building trades unions have voted to reject the "American Plan," but will permit their members to work under whatever terms they may be able to secure as individuals. This concession practically puts the American plan into effect in this territory.

South Carolina reports a marked decrease in rates paid common labor. The lowest figures prevail in Cherokee County, where the bottom rate is $1 and the highest $1.50 per day. The highest price paid anywhere in the states is $2.50 per day; teams, including the driver, bring from $4.50 to $5 per day.

Wages paid common laborers at the mines on the Minnesota ranges have been brought down to 30c. per hour, on about the 1917 basis. These men were receiving $5.55 per day as their top level, until last April. The feeling is that miners' wages now ruling are the minimum until factors outside the steel industry are adjusted downwards.

S means scarce; E, enough; P, plentiful—Higher rates indicated by +, decreases by—

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90P	$0.70P	$1.00P	$0.30P	.....	$1.00P	$0.20P
Baltimore	1.25P	.80P	.87½P	.54P	$0.74P	1.00P	−.30P
Birmingham	1.00P	.75P	.....	.25	.....	1.00P	.15@.25
Boston	.90P	.90P	.90P	.60P	.90P	.90P	.55P
Cincinnati	1.25P	1.00P	.70E	.85P	1.00E	1.25P	.35@.40
Chicago	1.25	1.25	.....	.....	.....	1.25	1.00
Cleveland	−1.04P	−1.04P	−1.04P	−.60P	−.91P	−1.04P	−.57½P
Dallas	1.00P	1.00P	1.00E	.60E	1.00E	1.00E	.50@75P
Denver	1.37½	1.00	1.00	.75@.81¼	1.00	1.00	.37½@50P
Detroit	1.00P	.80P	.80@.90P	.50@.60P	1.00P	.60@.80P	.50P
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.70
Los Angeles	1.25P	1.00P	1.00P	1.12½P	1.00P	1.00P	50@.56¼P
Minneapolis	1.00P	.80P	.80P	.65P	.....	.80P	.50P
Montreal	.90P	.65P	.60P	.40P	.50P	.65P	.30P
New Orleans	1.00P	.88P	.90P	.40P	.80P	1.00P	.30P
New York	1.25	1.12½	1.25	.87½	1.12½	1.12½	.75@.80
Pittsburgh	1.12½P	1.00P	1.00P	.80P	.....	1.00P	Open
St. Louis	1.25P	1.25P	1.25P	.85P	1.25P	1.25P	.67½P
San Francisco	1.25P	1.12½P	1.12½P	1.00P	1.12½P	1.12½P	.81¼P
Seattle	1.00P	.80P	.80P	.70P	1.00P	.87½P	.50P

Contractor Protests Seattle Anti-Alien Labor Bill

The contracting firm of Jahn & Bressi, Seattle, recently awarded a paving contract by the city has obtained an order restraining the city and the board of public works from cancelling the contract or interfering with the firm in carrying out its contract. The complaint of the contractors resulted from the recent order of the board of public works that all alien workers engaged in city improvement work be dismissed and their places given to registered voters and citizens of Seattle.

The contractors allege that their bid was submitted because of their reliance on the former conduct of the city, which permitted them to employ any men who were skilled in their work, as long as the contractor gave preference to those equally skilled in doing the work to the one who was a citizen of the United States and head of a family. The outcome of the case is being watched with considerable interest, as approximately twenty improvements jobs are affected by the order of the board of public works.

Waterborne Movement of Western Lumber Heavy

When transcontinental rail freight rates rose 33⅓ per cent a year ago, Pacific Northwest lumber began moving to Atlantic Coast markets through the Panama Canal. The break from car to cargo delivery has resulted in an increase of 5,898 per cent in waterborne intercoastal lumber shipments, the first six months of 1921 as compared with the first half of 1920, according to a recently-issued bulletin of the West Coast Lumbermen's Association.

Notwithstanding the tremendous increase in the water movement, the total volume of business of Pacific Northwest mills in Atlantic Coast markets is substantially less than it was a year ago. In addition to showing that Atlantic Coast lumber cargo shipments jumped from 1,564,505 ft. b.m. the first half of last year to 93,843,494 ft. b.m. the first half of this year, the report reveals gains in nine cargo markets and losses in a like number of overseas and coastwise markets, with a net loss of 13 per cent.

The California market, with 347,901,289 ft. b.m. delivered by water the first six months this year compared with 498,649,446 ft. b.m. for the same period last year, shows a loss of 30 per cent. The European markets show a loss of approximately 52 per cent. The west coast of South America 41 per cent. Australia, 58 per cent. China, 12 per cent.

Japan, rebuilding her six larger cities, and being the greatest per capita lumber consuming nation, bought heavily, recording an increase of 3¼ over the first six months of 1920. Japan thus far this year has taken 90,850,884 ft. b.m. as against 69,192,371 ft. b.m. last year.

Number Idle Cars Decrease

Due principally to the increased deman for transportation facilities a further decrease of 13,446 was reported in the number of freight cars temporarily out of service on Aug. 15 because of business conditions, compared with the total on Aug. 8, according to reports just received by the car service division of the American Railway Associations. The number idle on Aug. 15 was 499,594, compared with 513,040 the week before. Tabulations showed that of the total 284,338 were serviceable freight cars, while the remaining 215,256 needed repairs.

A reduction in the care shortage, which has been reported at certain points, was shown by the reports. On Aug. 15, this shortage was 2,125, or 1,239 below what it was on Aug. 8.

Computers Wanted by Coast and Geodetic Survey

The U. S. Civil Service announces open competitive examinations to be held Sept. 21 and 22 and Nov. 2 and 3, for computer. Vacancies in the Coast and Geodetic Survey for duty in Washington at $1,400 a year and Manila, P. I., at $2,000 a year are to be filled from this examination. Applicants should apply at once for Form 1312, stating the title of the examination desired, to the Civil Service Commission at Washington or to the secretary of the civil service board in any of the certain designated cities.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Railway Material—Standard, open-hearth rails in Birmingham $45@$47, as against $47.50, with reduction of 20c. per 100 lb. on light rails, all weights. Ties down 5c. each on white oak and 5@10c. on hardwood and red oak, in Chicago. Standard spikes in Chicago $3, as against $3.40; track bolts have dropped from $4.60 to $4.04 per 100 lb.

Pipe—Important decreases in cast-iron pipe in four cities. New York quotes 6-in. at $43.30, a drop of $5; the price in Birmingham is $38; in Chicago, $42.60 as compared with $48.10 last month; San Francisco down from $70 to $60 per net ton. Sewer pipe has advanced in Los Angeles, New Orleans and Baltimore, but is down in Birmingham, St. Louis, Boston, Detroit and New York.

Paving Materials—Road oils have declined another ½c. in New York, and 1c. per gal. in Chicago. Asphalt down $4 per ton in Chicago; down $10 per ton in packages, Baltimore. Granite paving blocks in Baltimore, $2.15, as against $2.25 per sq.yd. General decreases ranging from 10 to 50c. per sq.yd., on wood blocks.

Sand, Gravel and Crushed Stone—Gravel down 10 to 55c. in five cities. Sand down in Chicago, St. Louis, Los Angeles, Detroit and Birmingham. Crushed stone has advanced in Kansas City and Los Angeles and dropped in Chicago, Detroit and Baltimore.

Lime—Hydrated, finishing, down $6.25 in Detroit and $7.25 per ton in Baltimore; common hydrated down $5.25 in Detroit and $4.50 per ton in Baltimore. Common lump lime has declined in Chicago, Boston and New Orleans.

Cement—No change in New York, with the price $2.60@$2.70 net delivered. Down in Baltimore, Birmingham and Kansas City, while Los Angeles reports advance from $3.21 to $3.31 per bbl. net. Natural cement reported lower in New Orleans.

Common Brick and Hollow Tile—Brick has dropped $5 in Baltimore. Down $1 in Chicago, Boston and Detroit, delivered. Slight declines also in Birmingham and New Orleans. Hollow tile slightly lower in nine of the principal cities. Clay drain tile dropped $10 per 1,000 lin.ft. in New York on all sizes from 3 to 8 in.

Roofing Materials—Prepared roofings show average drop of 35c. in New York and 42@50c. per square in Philadelphia. Slate surfaced roofings now at $1.85, as against $2.80 per roll last month; slate finish shingles $5.40, as against $7.95 per square, carload lots f.o.b. Philadelphia.

Structural Material—Warehouse prices and quotations on mill shipments unchanged in New York. The regular Pittsburgh base of $1.85 and the warehouse base price of $2.88 for plates and shapes, effective. Mill reductions on tin plate and blue-annealed and galvanized steel sheets are reflected in warehouse quotations in Chicago, San Francisco and St. Louis. New York and Chicago prices on shapes, plates and bars are identical. Chicago quotes reduction of 20c. on structural rivets, present price $3.68.

Lumber—Sharp declines in price of yellow pine in Baltimore and Birmingham, and of Douglas fir in Los Angeles and New Orleans. Advance of $1@$12 in Kansas City and $1@$2 per M. ft. in Minneapolis.

Wood Piles—Pine piles, larger sizes, down $1@$1.50 in New York, $1@$2 in St. Louis.

Explosives—Reduction ½c. per lb. on all high explosives throughout the country.

Scrap—Quotations in New York, Chicago and St. Louis average $1@$4 lower per gross ton than last month.

Price advances since last month have been indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by **The Matthew Addy Co.**:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$24.50†	$45.60
Northern Basic	23.52†	51.30
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	22.52†	47.80
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	30.26†	49.70
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	20.00*	42.00@44.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	21.76†	50.00*
Virginia No. 2 (silicon 2.25 @ 2.75)	23.74†	50.00*
Basic	20.26†	48.00†
Grey Forge	22.26†	45.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	20.00*	46.40
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	26.66†	48.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	21.96	49.00
Basic	19.96	48.50
Bessemer	21.96	50.00

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$45.00	$55.00		$45.00
Standard openhearth rails	47.00	57.00	$45@47	47.00
Light rails, 8 to 10 lb.	45.00	50.00@55.00		2.45@3.00*
Light rails, 12 to 14 lb.	45.00	50.00@55.00	2.00*	2.41@2.95*
Light rails, 25 to 45 lb.	40.00	50.00@55.00	2.00*	2.32@2.85*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8 Ft. 6 In.
Chicago, White Oak	$1.35	$1.40
Chicago, Hardwood and Red Oak	1.20	1.50
Chicago, Empty Cell Creosoti g (add'l)	.45	.50
San Francisco, Green Douglas Fir	.80	1.12
San Francisco, Empty Cell Creosoted, Douglas Fir	1.76	2.48

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Sap Cypress
Grade 3	$1.25	$1.05	$.90
Grade 2	1.15	1.00	.90
Grade 1	1.10	.95	.70

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					San Fran-	Bir- m g
	Current	One Year Ago	Chicago	St. Louis	cisco	ham
Standard spikes, ⅜-in. and larger	$3.03	$4.00@4.25	$3.00	$4.00	$5.7	4 05
Track bolts	4.00	6.00@6.50	4.04	5.00	6.65	4.15
Standard section angle bars	2.75	3.00@4.00	2.75	3.25	4.50	3.25

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of July 7, 1921:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	64½	52	¼ to 1¼	39½	24½

LAP WELD

2	56½	44	15	48½	32
2½ to 6	60½	48	2	54½	20½
7 to 12	57½	44	2½ to 6	37½	24½
13 and 14	45	37	7 to 12	35½	22½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	62½	51	1 to 1½	39½	25½
2 to 3	65½	52			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	54½	43	2	35½	22½
2½ to 4	58½	47	2½ to 4	38½	26½
4½ to 6	57½	46	4½ to 6	37½	25½
7 to 8	53½	40	7 to 8	30½	18½
9 to 12	48½	35	9 to 12	25½	13½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	60%	62½%	58½%
3½ to 6 in. lap welded	51%	48½%	48½%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	46%	50%	38½%
3½ to 6 in. lap welded	37%	46%	34½%

Malleable fittings, Class B and C, from New York stock sell at net list prices. **Cast iron**, standard sizes, 20—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York					
	Current	One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	$48.30	$79.30	$40.00	$46.60	$49.70	$63.00
6 in. and over	43.30	76.30	38.00	42.60	46.70	60.00

Gas pipe and Class "A," $3 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$42.50	$35.00	$50.00		$55.00
4	50.00	60.00	85.00	60.00	$90.00	65.00
5	80.00	85.00	140.00	80.00	115.00	84.00
6	105.00	110.00	140.00	100.00	150.00	110.00
8	175.00	175.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In	New York Delivered	Pitts-burgh	Birming-ham	St. Louis	Chicago	San Fran-cisco	Dallas
3	$0.14			.1075	$0.135	$0.13	
4	.14		$0.09	.1075	.135	.1625	$0.18
5	.21			.15	.2025	.195	.165
6	.21		.135	.15	.2025	.2275	.25
8	.35		.225	.215	.315	.325	.35
10	.52			.30	.4725	.455	
12	.67		.3825	.387	.6075	.585	.80
15	1.15		.5625	.585	.81	.975	
18	1.55		.765	.765	1.125	1.365	
20	1.98		1.125	1.035	1.35		
22	2.64				1.80		
24	2.97		1.4625	1.35	2.025	2.34	2.40
27				2.25	3.75	3.25	
30			4.00	2.70	4.75	3.90	
33				3.75	5.50		
36				3.65	6.00		

	3	5	8	12	24	36
Boston	$0.114	$0.172	$0.267	$0.507	$1.71	$4.57
Minneapolis			.40	.77	2.58	5.66
Denver		.15	.30	.50	1.95	
Seattle	.145		.36	.72	2.59	
Los Angeles	.11*	.165*	.275	.495	1.65	
New Orleans		.108	.27	.459	1.755	
Cincinnati	.114	.171	.246	.513	1.710	4.61
Atlanta	.098*	.147*	.245	.4165	1.5925	
Montreal, *delivered*	.30*	.45*	.85*	1.35	4.50	6.50
Detroit	.105	.1575	.245	.4725	2.115	5.4325
Baltimore (*f.o.b.*)	.125	.2295	.357	.6885	2.295	5.23
Baltimore, *delivered*						

*4-in., 6-in., 9-in., 30-in. respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.05	$0.14
New York, 65% asphalt	(at terminal)	.05	.14
New York, binder	(at terminal)	.06	.13
New York, flux	(at terminal)	.05½	.14
New York, liquid asphalt	(atterminal)	.06½	.14
St. Louis, 50-60% asphalt (*f.o.b.*) *Tulsa, Okla.*		.02½*	.12
Chicago, 40-50% asphalt		.05	.10½
Chicago, 60-70% asphalt		.05½	.11½
Dallas, 40-50% asphalt		.10	.08
Dallas, 60-70% asphalt		.13	.10
Dallas, 75-90% asphalt		.15	.12
San Francisco, bunker, per ton		15.00	13.00

* Freight $21.75 per ton to Whiting, Ind.

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums, and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$24.00	$15.00
Boston	No quotations	
Chicago	24.50	17.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	21.50*	15.00*
Dallas	35.00	27.00
Seattle	27.50	21.50
Denver	45.00	65.00
Minneapolis	....	20.50
St. Louis	Sold out for 1921	
Baltimore	30.00	....
Los Angeles, *at factory*	22.50	15.00
Montreal	28.00	21.00
Atlanta	31.00	....
Detroit (petroleum asphalt)	24.50	20.00
Cincinnati	27.10	22.10
Maurer, N. J. (asphalt)	27@38	....
Maurer, N. J. (asphalt cement)	29@36	25@31

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00	per M
Chicago	About 4x8x4 dressed	3.35	sq.yd.
	About 4x8x4 common	3.00	sq.yd.
San Francisco	Basalt block 4x7x8	65.00	per M
Boston	5-in. granite	4.20	sq.yd.
Atlanta	Granite	2.00	sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107.00	per M
Baltimore	Granite	2.15	sq.yd.
Montreal	Granite	130.00	per M
New Orleans	Granite, 4 x 8 x 4	3.25	sq.yd.
Cincinnati	Granite	4.50	sq.yd.
St. Louis	4x8x4 dressed	3.35	sq.yd.
	4x8x4 common	3.00	sq.yd.
Kansas City	No. 1 Granite	3.95	sq.yd.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.70	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.09
New York	3½	16	2.17
New York	4	16	2.37
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	3.25
St. Louis	4	16	3.75
Seattle	4	16	Off market
Minneapolis	3½	16	2.13
Atlanta	3½	16	2.30
New Orleans	3	16	2.00
New Orleans	3½	16	2.35
New Orleans	4	16	2.65
Dallas	4	18	3.90
Baltimore	3½	16	3.65
Montreal, *delivered*	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	3.30
Kansas City	4	16	2.00@2.25

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.25	$3.00	$2.25	$3.00	$1.25	$1.50
Denver	2.00	1.40	1.80	1.80	1.60	1.00
Chicago	1.80	2.15	1.80	2.15	1.80	2.15
St. Louis, *per ton*	.90	1.50‡	.90	1.55	.95*	1.55
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas, *delivered*	3.09	2.50	3.50	2.50	2.50	2.00
Minneapolis, *at pit*	2.00	2.00	....	1.35	1.00	1.25
Cincinnati	2.25	....	2.25	1.50	1.69	1.45
San Francisco	2.25	1.50	2.50	1.50	1.50	1.50
Boston, per ton	2.65	3.50	2.65	3.00	2.00	2.75
New Orleans	2.85	3.05	....	....	1.35	1.55
Los Angeles, per ton	1.35†	1.25	1.45†	1.25	1.30†	1.15
Atlanta, per ton	2.25	2.25	2.25	2.25	1.35	1.15
Detroit	2.00	2.50	2.00	2.50	2.00	2.50
Baltimore, per ton	1.40	1.40	1.60	1.60	2.40	.70
Montreal, per ton	1.50	1.45	1.50	....	1.25	1.30
Birmingham, per ton	....	....	....	....	1.37	1.25‡

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 70c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.90@2.00	$1.90@2.00	$1.90@2.00	$2.15
Chicago	2.00	2.35	2.00	2.50
St. Louis *delivered*	1.60*	1.90	1.60*	1.90
Dallas	2.80	3.50	2.80	3.50
San Francisco	2.25	1.50	2.50	1.50
Boston, *delivered*	3.00*	3.00*	3.00	3.00*
Minneapolis, *at plant*	2.00	2.25	2.25	2.25
Kansas City†	1.50	2.35	1.50	2.35
Denver	....	3.75	....	3.75
Seattle *delivered*	3.00	3.50	3.50	3.50
Atlanta	2.25*	3.10	2.25*	3.10*
Cincinnati *delivered*	2.06	....	2.06	1.65
Los Angeles	1.60*	1.60*	1.70*	1.60*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.80*	1.65*	1.80*
Montreal	2.00*	2.30*	2.10*	2.30*
Birmingham *delivered*	3.20	....	3.10	

*Per ton. †F.o.b. Joplin, Mo.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Lebanon or Bethlehem, Pa.	$1.00	$1.00	$2.50	$0.90
Easton or Catasauqua, Pa.	1.00	1.00	2.00	.90
Buffalo, N. Y. and Erie, Pa.	1.25	1.25	2.25	1.25
Emporium, Pa.	1.25	1.25	....	1.25
East Canaan, Conn.	1.25	1.35	4.00	1.10
Birmingham, Ala.	.90	1.15	2.05	.80
Toledo, Ohio	1.50	1.50	2.35	....
Atlanta, Ga.	....	2.10	....	....
Eastern Pennsylvania and New Jersey	1.20	1.20	2.50	.90
Westrn Pennsylvania and New Jersey	1.25	1.25	2.50	1.25

Birmingham, f.o.b. sidings $1.12 (or $1.45 per cu. yd. on site)

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per 180-Lb. Barrel (net) Finishing	Lump, per 180-Lb. Barrel (net) Common
New York	$16.99	....	....	$3.69*
Chicago	20.00	....	....	1.65
St. Louis	24.00	$20.00	....	.70
Boston	24.25	20.25	$3.40	3.10
Dallas	25.00	....	....	2.75
Cincinnati	16.70	14.50	....	12.25‡
San Francisco	25.40	22.00	....	2.25
Minneapolis	29.00	22.00 (white)	....	1.80
Denver	30.00	2.95 (bbl.)	.95 (bu.)	....
Detroit	15.75	13.75	12.00 (ton)	11.00 (ton)
Seattle	27.00	....	3.50	3.25
Los Angeles	....	30.00	3.00*	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	28.00	....	15.00‡	....
Atlanta	19.00	16.00	2.00	1.50
New Orleans	....	17.25	....	1.75

* 280-lb. barrels (net). † Per bushel. ‡ Per ton.

Minneapolis quotes common lump lime Kelly Is. white; brown is $1.50.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.60
Kansas City (Ft. Scott)	1.60	1.60
New Orleans	3.16	3.36
Atlanta (Magnolia)	11.00 ton	1.90
Cincinnati (Utica)	1.87	2.85
Boston (Rosendale)	1.05@.95	2.35

PORTLAND CEMENT—Current prices are for barrels in carload lots, *with* or *without* bags, to contractors:

	Current Without Bags	One Month Ago	One Year Ago Without Bags
New York (delivered)	$2.60@2.70	$2.60@2.70	$4.22@4.25
New York, alongside dock to dealers	2.40	2.40	
Jersey City (delivered)	2.89	2.89	4.25
Boston	2.86	2.86	3.32
Chicago	2.17	2.17	2.15
Pittsburgh	2.17	2.17	2.20
Cleveland	2.43	2.43	2.42
Detroit	2.43	2.43	3.00
Indianapolis	2.43	2.43	2.42
Toledo	2.49	2.49	2.28
Milwaukee	2.39	2.39	2.20
Duluth	2.10	2.10	2.20
Peoria	2.45	2.45	2.32
Cedar Rapids	2.51	2.51	2.40
Davenport	2.47	2.47	2.36
St. Louis	2.90	2.90	2.85
San Francisco	3.09	3.09	2.88
New Orleans	3.20	3.20	3.52
Minneapolis	2.60	2.41	3.30
Denver	3.10	3.10	3.80
Seattle	3.10	3.10	3.03
Dallas	2.80	2.60	2.92
Atlanta	2.75	2.75	2.70
Cincinnati	2.62	2.62	2.85
Los Angeles	3.31	3.21	3.10
Baltimore (del.) drayl. ad lots	2.98	2.58	4.56
Detroit	2.43	2.43	5.00
Birmingham	2.85	3.05	....
Kansas City	3.05	3.20	2.76
Montreal	2.75	2.75	2.95

NOTE—Bags 10c. each, 40c. per bbl.; 80c. per bbl. in Montreal; 60c. per bbl. in Los Angeles.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds	Pittsburgh, Mill	New York (Warehouse)	Chicago	Dallas	San Francisco
032	0.022	$0.74	1.16	....	$1.15	$1.24
049	0.028	.94	1.45	....	1.46	1.56
068	0.035	1.14	1.74	....	1.80	1.92
093	0.045	1.46	2.23	....	2.30	2.46
126	0.057	1.80	2.69	....	2.86	3.07
153	0.068	2.14	3.18	....	3.40	.....
180	0.078	2.46	3.63	....	3.93	.....
245	0.103	3.24	4.74	....	5.15	.....
287	0.119	3.75	5.46	....	5.96	6.41
336	0.138	4.35	6.33	....	7.32	.....
395	0.160	5.04	7.30	....	8.00	.....

PAVING

036P	0.017	$0.56	....	....	$0.88	.....
053P	0.024	.79	....	....	1.24	.....
072P	0.031	.99	....	....	1.57	.....
097P	0.040	1.28	....	....	2.02	.....
049R	0.024	.79	....	....	1.24	.....
067R	0.031	.99	....	....	1.57	.....
089R	0.040	1.28	....	....	2.02	.....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27	233	$23.25	$23.39	$27.50	$34.20	$25.50
26	250	24.65	24.93	28.90	28.75	27.56
25	300	27.30	27.45	31.15	.....	30.71
24	340	29.10	29.33	33.10	33.06	33.16
22	433	33.80	34.06	.....	.....	35.10

* Material shipped from mill, freight allowed, or at warehouse. Delivery charge is 1c. per sq.yd.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	New York (Warehouse, Uncut)	Birmingham Mill	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	$1.75	$2.78	$2.00	$2.78	$3.02	$3.50	$2.35
⅜ and larger	1.80	2.83	2.35	2.82	3.07	3.55	2.40
½ and larger	1.85	2.88	2.35	2.88	3.12	3.60	2.45
⅝ and larger	2.00	2.93	2.35	3.03	3.27	3.75	2.60
¾ and larger	2.25	2.98	2.35	3.48	3.52	4.00	2.85

* Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¼ and larger	$1.90	$2.00	$3.25	½	$2.30	$2.25	$3.50
⅜ in.	1.95	2.05	3.30	⅝	2.30	2.50	3.75
½	2.05	2.10	3.35	¾	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 4-inch*
New York (del.)	$18.40	$18.40	$30.75	$47.00	$42.50
New York (at dock)	15@15.50	15@15.50	25.00	.....	.....
Chicago	11.00	12.00	16.00	34.00	42.50
St. Louis, salmon	17.00	17.00	16.00	.....	.....
Denver, salmon	14.00	14.00	17.00	.....	.....
Dallas	12.72	12.50	22.07	44.00	.....
San Francisco	18.00	18.00	18.00	.....	44.38
Los Angeles	15.50	15.50	13.50	(not used)	
Boston (del.)	17.00	18.00	30.00	46.00	56.25
Minneapolis (del.)	17.00	17.00	24@26	37.00	43.00
Kansas City	15.50	15.50	22.00	.....	.....
Seattle	14.00	14.00	15.00	48.00	53.50
Cincinnati	19.00	19.00	24.00	42.00	.....
Montreal (del.)	18.00	18.00	16.00	100.00	120.00
Detroit (del.)	17.00	16.25@18	23.00	41.30	44.00
Baltimore (del.)	20.00	25.00	20@25	40.00‡	.....
Atlanta	10.00	10.00	.....	40.00	.....
New Orleans	14.00	14.50	25.00	.....	.....
Birmingham	11.50	12.00	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots for hollow building tile:

	New York: Current on Trucks*	New York: One Year Ago	Chicago	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.11370	$0.2444	$0.0926	$0.090	$0.145	.....
6x12x12	.15160	.3259	.1343	.121	.12	.....
8x12x12	.20210	.4345	.1575	.165	.29	$0.17810
10x12x12	.....	.....	.1853	.218	.....	.22260
12x12x12	.....	.....	.2408	.250	.....	.26720

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.102	$0.190	$0.268
Minneapolis (f.o.b. cars)	.084	.161	.230
Minneapolis (delivered)	.092	.175	.250
Cincinnati	.0682	.128	.175
Kansas City	.100	.175	.225
Denver	.09	.16	.23
Seattle	.10	.175	.30
Los Angeles factory	.103	.185	.29*
New Orleans	.14	.25	.42
Detroit (delivered)	.070	.135	.225
Montreal	.20	.36	.35
Baltimore	.16	.26	.42
Atlanta	.0765	.136	.....
Dallas	.124	.....	.....
Birmingham	.095	.1785	.....

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	New York (del.)	Birmingham	Dallas	St. Louis	Chicago (del.)	San Francisco
Beams, 3 to 15 in.	1.85	$2.88	$2.10	$4.00	$3.12½	$2.88	$3.85
Channel 3 to 15 in.	1.85	2.88	2.10	4.00	3.12½	2.88	3.85
Angles, 3 to 6 in., ¼ in. thick	1.85	2.88	2.10	4.00	3.12½	2.88	3.85
Tees, 3 in. and larger	1.85	2.88	2.10	4.00	3.12½	2.88	3.85
Plates	1.85	2.88	2.10	4.00	3.12½	2.88	3.85

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.65	$4.40	$6.00	$3.68	$4.12½	$5.50	$5.50

CONE HEAD BOILER

½ in. and larger	2.75	4.50	7.10	3.78	4.22½	5.60	5.65
⅝ and ¾	2.90	4.65	7.25	3.93	4.22½	5.75	5.80
⅞ and 1	3.15	4.90	7.50	4.18	4.22½	6.00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.75@$3.00	$3.50	$4.75	$5.00	$3.46	$4.95
Cut	3.00@3.25	6.45	6.25	7.75	4.08	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$1.72	$2.08	$2.50	$1.55	$1.90	$2.25
No. 2 grade	1.42	1.73	2.10	1.25	1.55	1.85

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.85 per roll in carload lots and $2.10 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.40 per square in carloads; $5.65 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices per ton f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$3.25
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.52
Asphalt pitch (in barrels), per ton	47.50
Asphalt felt (light), per ton	80.50
Asphalt felt (heavy), per ton	84.50

SHEETS—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.75	3.72½	$3.53	$5.25	$3.53
No. 12	2.80	3.77½	3.58	5.30	3.58
No. 14	2.85	3.82½	3.63	5.35	3.63
No. 16	2.95	3.92½	3.73	5.45	3.73
Black					
*Nos. 18 and 20	3.40	4.80	4.45	5.80	4.05
*Nos. 22 and 24	3.50	4.85	4.50	5.85	4.10
*No. 26	3.55	4.90	4.56	5.90	4.15
*No. 28	3.65	5.00	4.65	6.00	4.25
Galvanized					
No. 10	3.75	5.00	4.75	....	4.25
No. 12	3.85	5.10	4.85	6.10	4.35
No. 14	3.85	5.10	4.85	6.10	4.35
Nos. 17 to 21	4.15	5.40	5.15	6.40	4.65
Nos. 22 and 24	4.30	5.55	5.30	6.55	4.80
*Nos. 25 and 26	4.45	5.70	5.55	6.70	4.95
*No. 28	4.75	6.00	5.65	7.00	4.25

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl.)	$0.78	$1.48	$0.75	$1.67

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	*12.25*	*13.75*	15.50	17.00	*12.25*	15.50
25 and 50-lb. kegs	*12.50*	*14.00*	15.75	17.25	*12.50*	15.75
12½-lb. keg	*12.75*	*14.25*	16.00	17.50	*12.75*	16.00
5-lb. cans	*15.25*	*16.75*	18.50	20.00	*15.25*	18.50
1-lb. cans	*17.25*	*18.75*	20.50	22.00	*17.25*	20.50

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

	Lumber Prices in Yards at San Francisco			
	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24.50	$25.00	$26.00	$28.00
3x6 and 8	25.50	26.00	27.00	29.00
4x4-6 and 8	26.00	27.00	28.00	29.50
3x10 and 12	26.00	27.00	28.00	30.00
3x14	26.50	27.50	28.50	30.50
4x10 and 12	26.00	27.00	28.00	30.00
4x14	27.00	28.00	29.00	31.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
†10	$25.50	$27.50	$28.50
6x14	27.00	29.00	29.50
8x10	25.50	27.50	28.50
3x14	27.00	29.00	29.50

New York, Chicago and St. Louis

	Southern Pine			
	New York*		Chicago	
	20 Ft. and Under	20-24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	*$30.00*	*$31.00*	*$41.00*	*$42.00*
3x10 to 10x10	*35.00*	*36.00*	*43.00*	*44.00*
3x12 to 12x12	*40.00*	*41.00*	*46.00*	*47.00*
3x14 to 14x14	*45.00*	*46.00*	*49.00*	*50.00*
3x16 to 16x16	*50.00*	*51.00*	*59.00*	*60.00*
3x18 to 18x18	*55.00*	*56.00*	*64.00*	*65.00*
4x20 to 20x20	.....	.....	*66.00*	*67.00*

* Wholesale price (to dealers) of long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

Price to contractors, on lighters or cars, New York, about $5 additional.

St. Louis: Yellow pine, 22@24 ft. long, 3 x 4 to 4 x 4, *$34.50*; 3 x 6 to 8 x 8, *$33*; 3 x 12 to 5 x 12, *$40*; 3 x 14 to 4 x 14, *$46*; 3 x 16 to 4 x 16, *$51*; 3 x 18 to 5 x 18, *$58*.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$45.00	$52.00	$55.00	$45.00	$55.00	$52.00
Seattle	.....	*19.00*	.....	.....	.....	*19.00*
New Orleans	26.00	*23.50*	.....	.....	31.09	27.00
Baltimore	*30.00*	.....	.....	.....	*28.00*	.....
Cincinnati	**38.00**	50.00	.....	.....	**45.00**	64.00
Montreal	70.00	85.00	68.00	78.00	78.00	100.00
Los Angeles	.....	*45.00*	*44.00*	.....	.....	*45.00*
Detroit	Quotations f. o. b. mills only					
Denver	.....	31.75	.....	.....	.....	*32.75*
Minneapolis	42.00	36.00	**33.00**	.....	49.00	*36.00*
Atlanta	27.50	.....	.....	.....	39.00	.....
Dallas	*31.00*	.....	.....	.....	*35.00*	.....
Kansas City	**40.00**	**47.00**	47.00	.....	**45.00**	**45.00**
Birmingham	30.00	.....	.....	.....	*34.00*	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$45.00	$48.00	$37.00	$43.00	$48.00
Seattle	.....	*14.00*	.....	.....	*16.00*
New Orleans, at mill	50.00	25.00	.....	30.00	.....
Baltimore	*36.50*	.....	.....	*28.00*	.....
Cincinnati	**62.50**	*80.00*	.....	**33.50**	.....
Montreal	120.00	60.00	60.00	80.00	80.00
Los Angeles	.....	*38.00*	*37.00*	.....	*63.00*
Denver	.....	29.75	.....	.....	27.75
Minneapolis	38.00	*31.25*	*30.25*	**37.00**	*29.25*
Atlanta	15.00	.....	.....	18.00	.....
Dallas	32.00	30.00	.....	*34.00*	.....
Kansas City	**37.00**	**21.00**	.....	36.50	**36.50**
Birmingham	**25.00**†	.....	.....	23.00	.....

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—†1x12x16. $2 additional per M. ft. for delivery

Detroit—General quotations not available. Rough fir, 2 x 12 and 2 x 4, by 16 ft. $44; 3 x 12 x 16 ft., $48; 2 x 4 x 16, $42.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.33½	Detroit	$0.33
Birmingham	.76	Kansas City	81½
Boston	.41½	New Orleans	51½
Buffalo	.29½	New York	38
Chicago	.38	Pacific Coast (all rail)	†1.66½
Cincinnati	*.325*	Philadelphia	35
Cleveland	.24	St. Louis	47½
Denver	1.35*	St. Paul	.66½

Note—Add 3% transportation tax. * Minimum carload, 40000 lb.

Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.00	$2.00	$4.00@$5.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Iron strand and iron tiller	10%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington: Galvanized iron rigging and guy ropes +12½%; bright plow 35% off.

Wyoming, New Mexico and Colorado: Plow steel, round strand, 35% off, galvanized iron rigging and guy rope +12½%.

Arizona: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Montana, Idaho and Utah: *30%* plow steel; +17½% galvanized iron rigging and guy rope.

Western territory not included in above: Plow steel, 35%; galvanized iron rigging and guy rope +12½%.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.18	New Orleans	$0.16
New York	.16½	Los Angeles	.14½
Chicago	.18	Seattle	.16
Minneapolis	.17½	St. Louis	.16½
San Francisco	.15	Montreal	.30
Atlanta	*.19*	Detroit	*.175*
Denver	*.18*	Baltimore	*.22*
Cincinnati	.17	Kansas City	.16½
Dallas	.29	Birmingham	.20½

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	*0.3075*	*$0.3425*
Boston	.24	.275
Kansas City	*.24*	*.275*
Seattle	*.1875*	*.2125*
Chicago	*.2275*	*.2525*
Minneapolis	.2299	.2555
St. Louis	.28	.315
Denver	.2375	.2725
Dallas	.29	.375
Los Angeles	.25	.27
Atlanta	*.26*	*.30*
Baltimore	*.2550*	*.27*
Cincinnati	.25	.2750
Montreal	.2150	.2550
Birmingham, *deli ered*	.1925	.2275
New Orleans	.2725	.3075

PILES—For plain pine piles, delivered New York, the price is as follows:

Pine 12-in. butts, 6-in. tops, length 41-50 ft	$9.00@11.00
Pine 14-in. butts, 6-in. tops, length 51-60 ft	*13.50@15.50*
Pine 14-in. butts, 6-in. tops, length 61-71 ft	*19.00@21.00*

Dallas		St. Louis	
6-in. x 20-ft	$4.60	6-in. x 30-ft	*$7.00*
		7-in. x 30-ft	*9.00*
6-in. x 30-ft	7.10	7-in. x 35-ft	*13.95*
		8-in. x 35-ft	*15.00*
8-in. x 30-ft	8.45	7-in. x 40-ft	*14.50*
		8-in. x 45-ft	*25.00*
8-in. x 35-ft	10.38	8-in. x 50-ft	*26.00*

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10.50	**$11.50**	*$9.00*
Stove plate	9.50	*12.00*	*10.50*
No. 1 machinery cast	*16.50*	*13.50*	*12.00*
Machine shop turnings	3.00	4.00	*4.00*
Cast borings	3.75	*5.50*	*5.50*
Railroad malleable cast	8.50	*12.50*	*8.50*
Re-rolling rails	**11.00**	13.00	12.00
Relaying rails	*30.00*	30.00	27.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco		Seattle
	Galv.	Black	Black
½	$9.10	$8.40	$8.55
⅝	8.65	6.65	8.25
¾	8.50	6.50	8.30

Pittsburgh base, *$3.25@$3.40* per 100 lb.